

A MODEL FOR SUSTAINABLE SOLID WASTE MANAGEMENT THROUGH AN  
ANALYSIS OF CHICAGO, ILLINOIS SOLID WASTE MANAGEMENT SYSTEMS

by

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A REPORT

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## **Abstract**

America's landfill space is quickly depleting as the population continues to experience rapid growth; as the population grows the amount of daily waste generated increases at an alarming as well. In fact, by the year 2024, America would have exhausted all land areas dedicated to landfills. Currently, nationwide mandated regulations or standards to decrease the amount generated solid waste, construction waste, composting waste, or reducing waste at the source; do not exists. The following report researches effective practices that would make a waste management system sustainable. In order to rate the sustainability of the management system, a score sheet was created drawing from literature written. By creating a score sheet, individual waste management systems are able to determine if they are indeed sustainable and/or in need of improvement. The City of Chicago, Illinois, was chosen as the city to be measured and has proven to have a promising future as a prototype in effective sustainable waste management practices.

## Table of Contents

Table of Contents .....	iv
List of Figures .....	vi
List of Tables .....	vii
Dedication .....	viii
Chapter 1 - Introduction.....	1
An Overview of Solid Waste Management .....	1
Why is Sustainable Solid Waste Management Important in America? .....	4
Chapter 2 - Literature Review.....	8
Reducing Waste: Recycling.....	14
Construction and Demolition Recycling.....	16
Composting Regulation .....	19
Source Reduction .....	20
Chapter 3 - Methodology .....	22
Sustainability Factors.....	24
Criteria for Grading.....	25
Limitations .....	30
Chapter 4 - Results for the City of Chicago.....	31
Government Policies and Procedures .....	31
Government Regulation Results.....	33
Waste Reduction Overall .....	34
Waste Reduction Results.....	38
Degree of Participation .....	39
Degree of Participation Results.....	42
Constructions and Demolition Regulations .....	43
Construction and Demolition Results.....	44
Composting Regulations and Availability .....	45
Composting Regulation Results.....	46
Source Reduction .....	47

Source Reduction Results.....	51
Chapter 5 - Conclusion .....	52
Bibliography .....	56
Appendix A - City of Chicago Department of Environment Construction or Demolition Site Waste Recycling Rules and Regulations .....	61
Appendix B - Composting Ordinance.....	67

## **List of Figures**

Figure 1.1: Solid Waste in America (Hanson, 2008).....	5
Figure 2.1: MSW total generation rates, 1960 to 2008 (EPA, 2009) .....	10
Figure 2.2: MSW per capita generation rates, 1960 to 2008 (EPA, 2009) .....	11
Figure 2.3: Solid waste percentages (El-Haggag, 2007) .....	13
Figure 4.1: Blue bag results percentage (Chicago Recycling Coalition, 2008).....	35
Figure 0.2: Blue Cart pick-up (Chicago Recycling Coalition, 2009).....	36
Figure 0.3: Chicago wards (Chicago Reader, 2011).....	37
Figure 4.4: Example of a two-falt building (Picture by Kala Raglin, 2009).....	40
Figure 4.5: Dumping of black bins (Picture by Kala Raglin, 2009).....	40
Figure 4.6: Drop off boxes (Picture by Kala Raglin, 2009).....	40
Figure 4.7: Chicago wards with drop off boxes (Chicago Department of Streets and Sanitation, 2009).....	41
Figure 4.7: Total waste generated in Chicago 1998-2000 .....	50

## List of Tables

Table 1.1: Totals of State Waste Imports and Exports (Biocycle, 2000) .....	6
Table 2.1: Generation, materials recovery, composting, combustion with energy recovery, and discards of MSW, 1960 to 2008 (in millions of tons) (EPA, 2009) .....	12
Table 3.2: Sample Score Sheet .....	24
Table 3.3: Criteria for Government Regulations .....	26
Table 3.4: Criteria for Waste Reduction .....	26
Table 3.5: Factors for Recycling Degree of Participation .....	27
Table 3.6: Factors for Construction and Demolition Recycling .....	28
Table 3.7: Factors for Composting Regulation.....	28
Table 3.8: Factors of source reduction.....	29
Table 4.1: Government Regulation results .....	34
Table 4.2: Blue Cart Results 2007 and 2008 .....	37
Table 4.3: Blue Cart results 2009 .....	38
Table 4.4: Chicago source reduction results .....	51
Table 5.1: Chicago's overall results .....	52

## **Dedication**

I would like to dedicate this report to my mom, Karen Raglin, my sister, Dara Raglin Shelton, and my brother, Michael Heggie, Jr. Thank you guys for being my rock even when giving up was that much easier. Our journey has just begun. Love you guys.

“My little children, let us not love in word, neither in tongue; but in deed and in truth”

1 John 3:18



## **Chapter 1 - Introduction**

Fifth Element is a motion picture created in 1997 starring Bruce Willis as Korben Dallas, a vigilante living New York City in the year 2247 AD. While this is one of my favorite movies of all time, there was one scene in particular that concerned me even as a teenager. Attempting to escape from the law enforcement, Willis hid his vehicle in a skyscraper over flowing with New York City's solid waste. When the police approached the building, he police responded with "how are we supposed to find anything in all this garbage". In observation, it seemed that the city exhausted all land resources in which to place their solid waste and simply discarded different types of waste wherever space was available, including in abandoned buildings. Fifth Element is based on fictional characters and a fictional plot, however this movie could hold some truth as far as the randomly placed garbage is concerned. As New York was depicted in this film, if we do not make major changes to our current solid waste management systems, our cities too may become overwhelmed with our day-to-day wastes.

### **An Overview of Solid Waste Management**

In the early 20<sup>th</sup> century, solid waste management consisted of burning waste at individuals' homes, at work, or at an open burning site. Schools and businesses burned each day's waste in an incinerator located in their basements. The ashes of burned trash were then hauled out to uncontrolled sites with the rest of the city's garbage. Burning trash, at the time, seemed satisfactory despite the noxious smoke that was emitted into the atmosphere (Hanson, 2008).

In 1929 the first 'sanitary fill' was used in Fresno, California. Sanitary fills are landfill sites where waste is isolated from the environment until deemed safe (Environmental Strategies for Cities, 2008). Since that time, Congress has passed solid waste regulations to solve problems that have occurred while handling America's waste, such as: ground and surface water contamination and dumping of hazardous waste.

In response to the United States continually growing waste management issues, the Solid Waste Disposal Act (SWDA) was created in 1965, as well as the Environmental Protection Agency (EPA) created in 1970. “The Solid Waste Disposal Act of 1965 was the first federal effort to improve waste disposal technology. Its principal aim was regulation of municipal waste disposal technology, while recognizing that solid waste management was essentially a local issue. The Environmental Protection Agency was tasked with developing standards for waste disposal” (EPA: Solid Waste Management on Tribal Lands, 2009, para 9)

The EPA’s main focus was to address the growing demand for cleaner water, air and land. “[The Environmental Protection Agency’s] mission is to protect human health and to safeguard the natural environment” (EPA: Mission Statement, 2009, para 1). The EPA was also created to combine different federal research, monitoring, standard-setting and enforcement activities in order to provide environmental protection. Current waste management practices, among other factors, produced significant amounts of pollution which includes waste dumping into water, the release of carbon emissions, and the unsustainable use of land filling. This type of practice was once, and is currently, utilized by multiple cities in America including Chicago, Illinois. Earlier solutions of waste management in Chicago consisted of steel mills and dumping slag on nearby land including areas where residences were located. “Sewage treatment, begun in 1922, generated sludge which was dumped on land. And though public pressure was occasionally effective in addressing careless waste disposal, often there were no barriers to unsafe practices” (Thale 2005, para. 5)

“Prior to the establishment of the EPA, the federal government was not structured to make a coordinated attack on the pollutants that harm human health and degrade the environment” (EPA: Mission Statement, 2009, para 13). Though SWDA and the EPA were created to set some type of regulation for solid waste management, it just wasn’t enough. “On one hand, waste management can be highly costly and on the other hand improper handling of waste can have a harmful effect on life and habitat and after some time lead to depletion of our natural resources” (El-Haggar, 2007). The need for further regulation was illustrated in the Love Canal debacle.

The Love Canal connected the two levels of the Niagara River separated by the Niagara Falls. Unfortunately, the canal was used as a toxic waste disposal site starting in the 1920's. The City of Niagara Falls disposed of waste from its petrochemical industry in the canal and later in time, the United States Army allegedly used the Love Canal to bury waste from experiments in chemical warfare. In 1942, Hooker Chemical and Plastics Corporation expanded the site for their own personal use. By 1947 the corporation had dumped around 22,000 tons of toxic waste into the canal. After the Hooker Chemical and Plastics Corporation filled the canal to capacity in 1952, the corporation back-filled the canal and covered it with four feet of impermeable clay (Steer, 2007).

During the early and late fifties, the Niagara Falls area was experiencing a rapid growth in population. The local school district was in search for a building site for a new school and approached Hooker Chemical to sell the land that hadn't been filled with toxic waste. Even though Hooker Chemical explained and showed the school board that the site was dangerous, the board still insisted on buying the property. The company sold the entire site to the board for the value of one dollar, which included a seventeen-line caveat explaining the dangers of building on the site. During construction, the layer of clay keeping the chemicals safeguarded, was punctured, however construction continued (Steer, 2007).

In 1957 the City constructed a sewer system to service a mixture of low income and single-family residences adjacent to the contaminated site. The sewer construction allowed the clay seal to be broken again and this time the walls of the canal were breeched. The effects of the chemicals were catastrophic. Residents begin to visually see the chemicals surfacing in their yards; the cancer rate in the neighborhood rapidly increased; there were also a significant number of birth defects that caused some alarm (Steer, 2007). "The regulatory pace quickened with the advent of the Love Canal debacle with the subsequent passage of the 1976 Resource Conservation and Recovery Act (RCRA), which imposed criteria for ground water protection and landfill gas mitigation control" (Hanson, 2008, para. 4).

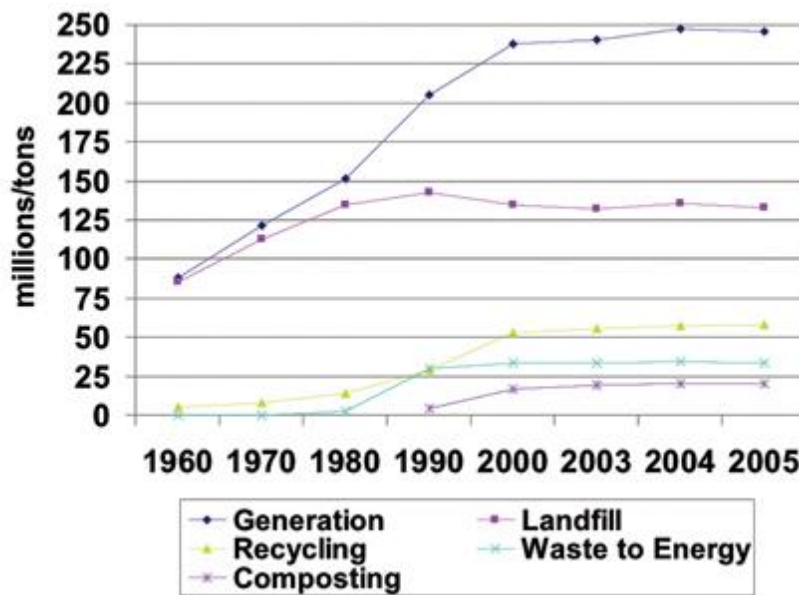
In 1984, the RCRA Hazardous and Solid Waste Amendments granted the EPA regulatory authority over landfills to make improvements (Hanson, 2008). The amendments allowed the EPA to set standards for generators and transporters of hazardous waste, operators of hazardous waste treatment, storage, and disposal facilities. “These standards are applied through a permitting program, a manifest system, and other administrative mechanisms to, in effect, track and deal with the wastes “from the cradle to the grave” (EPA Press Release, 1984, para. 2). Although, the Hazardous and Solid Waste Amendments addressed hazardous waste specifically, it directly affected solid waste because during the that time, hazardous and solid waste was treated the same. The RCRA amended the Solid Waste Disposal Act because it allowed for loopholes to be created allowing forty million metric tons of hazardous waste to escape control annually through the unregulated burning and blending of hazardous waste in landfills (Hall, 2001).

Despite the intentions of these acts and amendments, ultimately, what was created was a “dry tomb” concept. “A solid waste ‘Dry Tomb’ consists of an open dump in which each day’s waste is covered by a few inches of soil (classical sanitary landfill) where compacted soil (clay) and plastic sheeting are used to try to isolate the untreated municipal solid waste from moisture” (Lee, 1996, 89). This ‘dry tomb’ philosophy of physically encapsulating waste piles is currently still the dominant landfill practice in America.

### **Why is Sustainable Solid Waste Management Important in America?**

According to the Smith Barney report, the United States’ remaining landfill capacity was 21.3 years as of 2003, or landfills will have reached capacity by the year 2024 (Hanson, 2008). In 2006, the United States generated approximately 230 million tons of solid waste, which is about 4.6 pounds per person per day (Annenberg Media, 2008). Less than one-quarter of the generated waste is recycled; the rest is incinerated or buried in landfills. Out of the 230 million tons of solid waste that is generated, more than 70 percent of what ultimately becomes landfill could actually be reused; this includes valuable materials such as glass, metal, and paper (Annenberg Media, 2008). The generation of waste in the United States is illustrated in Figure 1.1.

**Figure 1.1: Solid Waste in America (Hanson, 2008)**



The trends shown in Figure 1.1 are only the waste that is generated by the citizens of America. The United States also has to handle waste that is imported to the country. From 1997 to 2000, there was approximately 48 million tons more of waste imported than exported in the 50 states and Washington D.C. The extra waste that is imported from outside of the United States is from countries, which would include: European countries, Canada, Mexico, and Puerto Rico. Currently in the United States, there isn't a law prohibiting the import of hazardous or non-hazardous waste from other countries, or the exporting of waste to other countries (Biocycle, 2000). The EPA only tracks hazardous wastes imports, thus by subtracting the annual total states "exported" waste from "imported" waste, the amount of foreign "municipal" waste is obtained (Table 1.1).

**Table 1.1: Totals of State Waste Imports and Exports (Biocycle, 2000)**

Year	Waste Imports (tons)	-Minus Exports	=Foreign Waste
1997	21,319,000	-13,977,000	=7,342,000
1998	32,837,370	-14,899,090	=17,938,280
1999	38,901,100	-16,090,000	=22,811,100
Totals	93,057,470	-44,966,090	=48,091,380

“The total amount of waste generated in the United States has increased each year and will continue to do so. “The steady growth of garbage is due primarily to increasing population” (Tammemagi 1999, 39). Population experts believe that the ideal population for the U.S. should be around 100 to 150 million people, compared to our current population of approximately 306 million people (U.S. News Staff, 2008). This is broken down to one birth every seven seconds, one death every 12 seconds, one international migration (net) every 36 seconds; and a net gain of one person every 13 seconds.

The ideal Sustainable Solid Waste Management goal would be waste emissions equals to zero. However, since zero waste is practically unattainable, the closest the nation can achieve to zero waste emissions, is desirable. Currently the United States continues to use ancient solutions of controlling waste. Specifically, there are three main solutions that are currently being implemented. *We can Bury It*, *We Can Burn It*, and *We Can Pay someone to Take It*. “We can bury it” concept is the simplest solution, however according the Environmental Protection Agency; landfills are closing at a rapid rate due to reached capacity and are frequently causing ground water pollution. “We can burn it”, or incineration, concept does generate energy, however at a cost. Incineration releases toxins into the air and creates fly ash that requires disposal in hazardous-waste landfills. “We can pay someone to take it” approach is not likely. As the population increases, local and state government officials are dealing with the costs and problems of their own waste disposal, they are less willing to import other communities' waste and the pollution it generates (Annenberg Media, 2008).

If solid waste management isn't addressed in a sustainable way, our cities may become like the image of the garbage-infested New York City depicted in the Fifth Element. Even though current technologies such as incineration and 'waste to energy' facilities are being used, these solutions only seem to be a piece meal approach to a larger solution. Due to limiting landfill capacity, there is urgency in finding better solid waste management solutions. "Over the past several years, the number of landfills has decreased from almost 8,000 in 1988 to 1,767 in 2002. Many landfills closed because they could not meet federal environmental standards. The size of the average landfill, however, has increased" (Keep America Beautiful, 2006, para 2). Sustainable solid waste management is not just finding out about the best practices, but about finding a solution where waste management can be self-sustainable for years to come without the cost to our land space, environment, and quality of life.

There are cities throughout the United States, such as Chicago, Illinois, that have recognized the problems and have begun to look further into sustainable solid waste management by incorporating systematic approaches and mandated regulations. However, there is not a clear definition or rating system, to determine if a city's waste management is sustainable. Therefore, this report will conduct an analysis on solid waste management and will use to develop scorecard. The score sheet will be used to rate the City of Chicago as a prototype, based on location, to determine if its efforts are indeed sustainable. A list of criteria was developed through a series of literature, as well as, incorporating the Environmental Protection Agency's guidelines and regulations as it pertains to waste management. Through the practical application of the developed scorecard, it is hoped, that Chicago would become a strong example of sustainable solid waste management for other cities to follow. However, Chicago may also be considered as a trial and error of finding best practices of waste sustainability.

## **Chapter 2 - Literature Review**

The following literature review recognizes that there are various or a number writings on the issues that pertain to solid waste management. There are also literature that pertains to a more sustainable approach to handling solid waste such as, recycling. In order to determine whether or not a city is implementing sustainable waste management practices, a system in which the process is measured has to be developed. Thus, by pulling out the key factors of the literature review, a score sheet will be developed to provide guidance in measuring waste sustainability, which may be applied to any city's waste management process.

The United Nations Conference on Environment and Development Earth Summit of Rio de Janeiro of 1992 challenged the world to focus on pressing global environmental problems and to agree on major treaties on biodiversity, climate change, and forest management. The summit brought 30,000 individuals together, including 100 heads of states, to come to a consensus on the direction the world needs to take on environmental sustainability. The summit addressed the main issues it intended to and also created Agenda 21, which served as a "blue print" and a commitment for sustainable development. The Earth Summit of Rio De Janeiro sparked many writings that focused on the idea of what is the notion of "sustainable development" (United Nations, 1997).

Though the summit challenged the world to incorporate sustainable development into their countries and government, we are still faced with the same environmental and economical problems today. Scientific and technological developments over time have provided a gateway for human capacity to extract natural resources, process them, and use them. What has not been addressed, are parallel solutions of how these resources can be entered into a new cycle of extraction, processing and use. Ultimately, most resources being extracted are used in unsustainable activities and end up as waste or also known as the "cradle-to-grave" scenario (El-Haggar, 2007).



El-Haggar also points out that the summit failed to explain the direction for measuring sustainability. “We need first to think about how we can develop sustainable projects and industries, and think about how we can develop indicators to measure the sustainability or percentage of sustainability within these projects and industries” (El-Haggar, 2007). Sustainable Solid Waste Management can also be known as Sustainable Environmental Development of Solid Waste. In order to measure the sustainability of waste management, it is important to understand what it is meant by sustainable development.

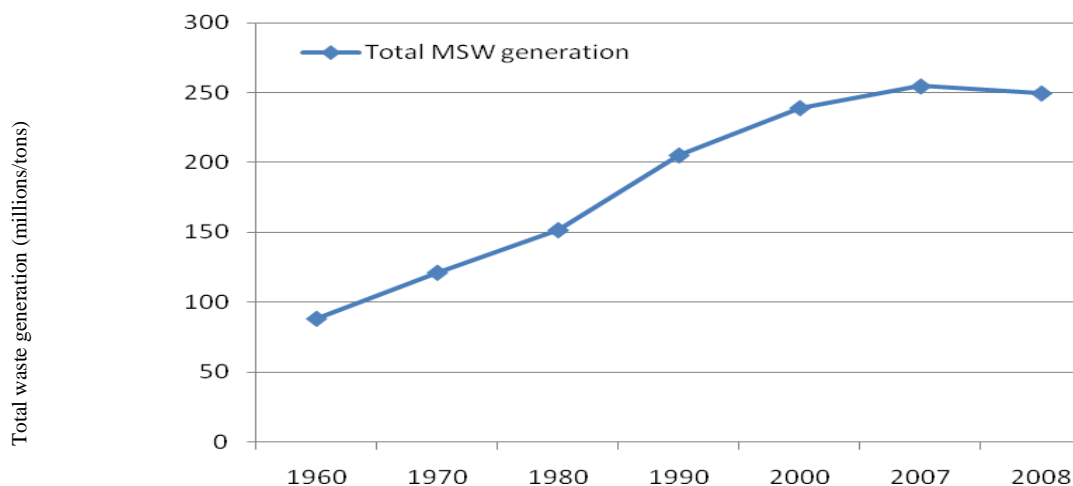
Sustainable Development is a two-word phrase that can have more than one meaning. “Sustainable” implies a system that is capable of renewing itself, or constant rebirth, which implies forever. “Development” is related to change, growth, expansion, and production. “Both words speak of time, evolutionary processes, constructive adaptation” (Porter, 2000). Thus, in order for a development to be sustainable it must somehow incorporate renewal of matter, resources, populations, and cultures. In order for sustainability to incorporate development, change and adaptation must take place. Thus, Sustainable Solid Waste Management can be defined as the adaptation of environmental sensitivity by using alternative solutions to waste management that breaks away from the cradle-to-grave scenario.

William K. Reilly, once Director of the Environmental Protection Agency, was off quoted to say, “We aren't yet in a garbage crisis, but one is clearly on the horizon” (Feiock & West 2008, 400). Almost everything we do from day to day creates some type of waste. The EPA defines solid waste as any “garbage, or refuse, and any discarded material including solid, liquid, semi-solid, or containing gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities” (EPA: Municipal Solid Waste Program, 2009, para 1) As the world population continues to grow, the need to control wastes becomes increasingly important.

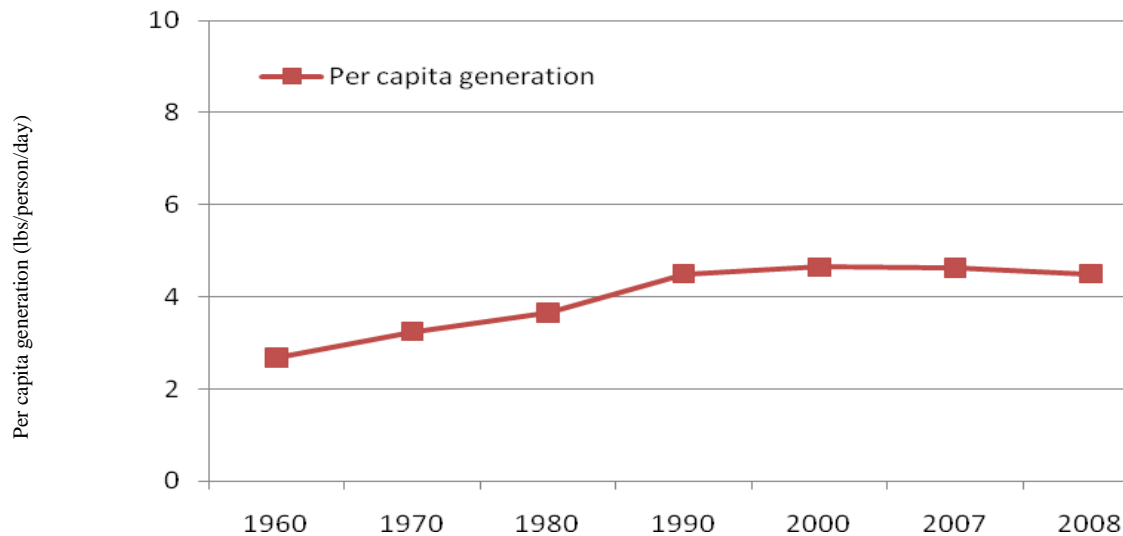
“In the late 1980’s, when [the] disposal crisis seemed imminent, there was tremendous enthusiasm for reduction in waste generation and disposal” (Dernbach 2002, 467). As a result, most of today’s policy on solid waste, and the hierarchy, were created. However, while the ideas are sound, programs and practices clearly need revitalization. Dernbach suggests that the United States has to be prepared to address its growing complacency with regard to easy, but unsustainable, waste management “solutions”.

Solid Waste Management (SWM) is defined as “wastes generated by households and wastes of a similar nature generated by commercial and industrial premises, by institutions such as schools, hospitals, care homes and prisons, and from public spaces such as streets, markets, slaughter houses, public toilets, bus stops, parks, and gardens” (United Nations Human Settlements Programme, 2010, 6). In 2006 the EPA reported U.S. residents, businesses, and institutions produced more than 4.6 pounds of waste per person per day, which is approximately, 251 million tons of municipal solid waste a year. The amount of solid waste generated has been steadily increasing over time (Figure 2.1). Also, American industrial facilities generated and disposed of approximately 7.6 billion tons of industrial solid waste each year. By the CEPA definition and the statistics from the EPA, though some improvements have been made, overall waste management in the United States has been lacking in controlling, recycling, and reusing generated waste shown in Figure 2.1 and 2.2.

**Figure 2.1: MSW total generation rates, 1960 to 2008**  
**(EPA: Municipal Solid Waste Generation, 2009)**



**Figure 2.2: MSW per capita generation rates, 1960 to 2008**  
**(EPA: Municipal Solid Waste Generation, 2009)**



Through a coordinated mix of practices, people across the country are creating ways to reduce waste that includes source reduction, recycling (including composting), and disposal. The most environmentally sound management of Municipal Solid Waste (MSW) is achieved when these approaches are implemented according to EPA's preferred order: source reduction first, recycling and composting second and disposal in landfills or waste combustors last (EPA: Reduce, Reuse, Recycle, 2009). Perhaps if the reduction of waste isn't left up to the individual household, but is seen as an entirely separate system as Sustainable Solid Waste Management, then the quest for the reduction of waste and land fill dependency will decrease.

Overall, the record of the United States in achieving sustainable solid waste management, including steady state or decreasing levels of waste generation and disposal, is mixed. "Recycling and composting rates have increased dramatically and the portion of the U.S. population with access to curbside recycling has doubled to over 140 million people, helping to decrease the percentage of MSW that is land filled" (Dernbach 2002, 467). This trend is also represented in Table 2.1.

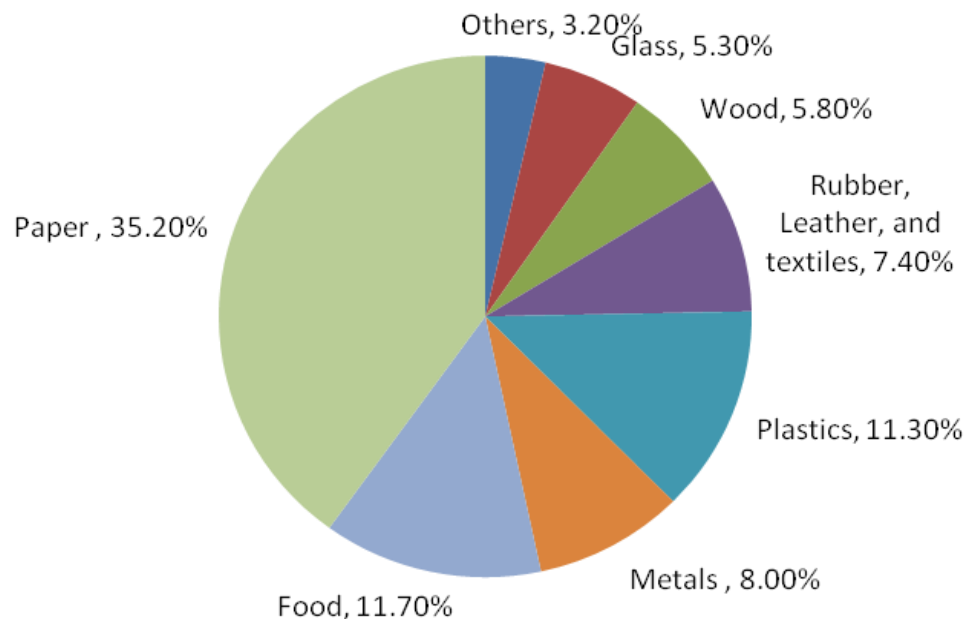
**Table 2.1: Generation, materials recovery, composting, combustion with energy recovery, and discards of MSW, 1960 to 2008 (in millions of tons) (EPA, 2009)**

Activity	1960	1970	1980	1990	2000	2003	2005	2007	2008
Generation	8.1	121.1	151.6	205.2	239.1	242.2	249.7	254.6	249.6
Recovery for recycling	5.6	8.0	15.5	29.0	52.9	55.6	58.6	62.5	60.8
Recovery for composting	/a	n/a	n/a	4.2	16.5	19.1	20.6	21.7	22.1
Total materials	.6	8.0	14.5	3.2	69.4	74.7	79.2	84.2	82.9
Combustion Energy Recovery	.0	0.4	2.7	9.7	33.7	33.1	31.6	32.0	31.6
Discards to landfills/ other disposal	2.5	112.7	134.4	142.3	136.0	134.4	138.9	138.4	135.1

“The modest definition of Sustainability (for solid waste modeled with future generations in mind) includes steady state or decreasing levels of waste generation and disposal” (Dernbach 2002, 467). Thus, to determine whether a SWM is sustainable or not, the reduction over time is important to study. In order to verify trends, a reliable measurement system is required. Dernbach suggested three indicators to measure the sustainability of solid waste practices. The first indicator explores whether generation per person has increased or decreased; the second indicator considers whether waste generation is likely to be decoupled from changes in gross domestic product (GDP); and at the most basic level, the third indicator asks, whether, even if waste generation is rising, more or less waste is being land filled owing to increased recycling, composting, and recovery.

P. R. White, 1999 states that waste is a by-product of human activities. Generally, wastes contain the same materials that are found in useful products, the difference is the lack in value. If value is restored to 'waste', at that point it ceases to be waste, which may become a basic way to handle waste. White and the EPA both indicate that recycling is a large part of the reduction of solid waste (Figure 2.3). The United States must be prepared to address its growing complacency with regard to easy, but unsustainable, waste management "solutions".

**Figure 2.3: Solid waste percentages (El-Hagggar, 2007)**



## **Reducing Waste: Recycling**

Recycling is vital to a sustainable waste management system. In 1990, the EPA offered a partial solution to the waste problem, by increasing the recycling share of the garbage pile from 10-15 percent to 25 percent by 1992. “The responsibility and expertise for accomplishing this goal rests not in Washington, but in city governments throughout the country” (Feiock & West 1993, 400).

Recycling has different benefits that the EPA recognizes: it protects and expands U.S. manufacturing jobs and increases U.S. competitiveness; recycling reduces the need for land filling and incineration; it prevents pollution caused by the manufacturing of products from virgin materials; it saves energy; it decreases emissions of greenhouse gases that contribute to global climate change; it conserves natural resources such as timber, water, and minerals; and it helps sustain the environment for future generations. The White House Task Force also recognizes the same benefits as outlined in “Recycling ...for the future” written in 1998 by the White House Task Force on Greening the Government Through Waste Prevention and Recycling.

Despite the many benefits, recycling struggles against four main factors: lack of effective federal plan, foreign waste imports, U.S. domestic waste exports, and over population. Currently there aren't any federal infrastructures or federal standards to support waste reduction; therefore, recycling cannot “compete” with waste disposal. The Solid Waste Disposal Act of 1976, also known as the Resource Conservation and Recovery Act (RCRA), was established to mandate states to develop and implement plans to maximize recycling and minimize waste. The plan implies these actions should have taken effect by 1980; however, the EPA stopped enforcing the 'state plan' requirements during President Reagan's Administration. There has not been any oversight of state plans by the EPA since 1987 (EPA, 1984).

The EPA outlines three steps to recycling a product which includes: collecting recyclable materials that would otherwise be considered waste, sorting and processing recyclables into raw materials such as fibers, manufacturing raw materials into new products, and purchasing recycled products. “Collecting and processing secondary materials, manufacturing recycled-content products, and then buying recycled products creates a circle or loop that ensures the overall success and value of recycling” (Reproduced By EPA, 2009).

H. Y. Tammemagi states that there was an argument put forth that recycling, source reduction and other conservation efforts should replace the use of landfills. This argument was an attempt to return to the recycling and conservation ethic that deemed successful in the early 1900’s and during the two world wars. In reality, how much of our municipal waste can actually be recycled? “In consideration for our environment, we should be aiming for the ultimate target of no waste emplacement in landfills” (Tammemagi, 1999, 39).

A successful waste recycling program relies on more than systematic application of equipment and other resources. A successful program also depends on attitude and strong participation. It’s found that mandated regulation is more successful than relying on individuals to participate in recycling endeavors. However, with regulation there also has to be education to the people of the community. “Public education is an indispensable part of an integrated waste management system” (Tammemagi, 1999, 46). Education would include, pick up days, how to obtain recycle containers, what materials can and cannot be recycled, how they are to be sorted, etc. There are several effective forms of communication cities may utilized including flyers, newsletters, paper ads, and local television channels.

## **Construction and Demolition Recycling**

“C&D waste is considered to be one of the priority waste streams and appropriate actions needed to be taken with respect to its effective management” (Kourmpanis alt, 2008, 267). When planning for sustainable waste management systems, Construction and Demolition (C&D) Recycling is also important to consider because “solid waste was defined to include any non-hazardous waste sent off-site for final disposal, incineration, recycling, or composting” (Dernbach 2002, 471). Thus, C&D waste is considered a waste stream and is included when managing solid waste.

The composition of construction and demolition waste may vary depending on the type, shape, age, use, size, and the main material of the building or civil infrastructure. There are four main origins of C&D waste. The first is waste arising from total or partial demolition of buildings and/or civil infrastructure. These materials may be comprised of soil; gravel; construction materials of water flow system; pieces of concrete; ceramics; bricks; overlay plates; tiles; plaster; sand; stones; pieces of sanitary ware; etc. The second origin of C&D waste arises from construction of buildings and/or civil infrastructure. “These materials consists of concrete, wood, plastic, paper, ceramics, bricks, tiles; plaster and all those materials deriving from the operation of construction, repairing, propping, accretion, expansion or renovation activities” (Kourmpanis alt, 2008, 267)

Soil, rocks and vegetation from land leveling, excavation, civil works, and/or general foundation are the third origin. This origin includes excavated soil, sand, gravel, rocks and clay. These types of waste that occur during excavations are found in almost every construction activity, especially underground construction, and geotechnical engineering works. The composition of the waste materials from excavation vary based on geological characteristics. The fourth origin of C&D waste is road planning and associated materials arising from road maintenance activities. These materials may include asphalt and all pavement materials such as sand, gravel, metal and materials coming from road dismantling and renovation.



“The construction and demolition industry generates a significant quantity of waste, most of which ends up in landfills. Estimates indicate that C&D waste accounts for up to 25 % of all waste delivered to some landfills” (Higgins, 1995, 389). C&D waste is a concern because the volumes of waste generated consumes a large portion of already limited landfill space. C&D also produces hazardous waste when materials such as paints, solvents, and adhesives are used. If a city concentrates on C&D recycling, it can significantly reduce the amount of solid waste going into its landfill.

According to the European Community Waste Strategy 2001, “construction and demolition waste is considered as one of the priority waste streams, while in the framework of the Sixth Environment Action Program entitled *Environmental 2010: Our Future, Our Choice*, actions need to be taken with respect to the effective management of this waste stream. “Construction and Demolition waste management [can take] advantage of opportunities for source reduction, materials reuse, and waste recycling” (Kibert, 2008, 448).

“Current application is based on an ever increasing knowledge concerning design, behavior, durability and sustainability of construction with these materials” (Hendriks, & Pietersen, 2000, IX). In 2000, there was a realization that there have been successful results with the reuse of asphalt and concrete in road construction and the reuse of brick, at that time, was still under investigation. Today, the use of Green Leaf Brick that is composed of 100 percent recycled materials, are available as an option for construction material (Green Leaf Brick). “In general, the environmental impact of the total construction process is improved by applying secondary or reused materials, thus conserving natural landscape and existing ecological values” (Hendriks, & Pietersen, 2000, IX). This is achieved by finding alternative materials, or reuse of materials, with less dependence on raw materials.

Building and Construction can be viewed as a cyclic process or as a never-ending cycle. Stage one of the cycle is using raw material supplies; stage two is the manufacture of construction materials and plants; stage three is actual construction (useful application); stage four is use and management (that uses energy and releases waste emissions); stage five is demolition.

“From a “sustainable” point of view, it is clear that a closure of this circle may be established by aiming at a near 100 percent recycling of construction and demolition waste”. In order to close the circle, requires the extraction and the reuse of materials after demolition (Hendriks, & Pietersen, 2000, 4).

Hendriks and Pietersen point out that most of C&D waste is comprised of building materials that were used about 50 to a100 years ago. Though most of these materials may be recycled, there is another option in which to reduce construction and demolition waste. The generation of C&D waste may be prevented during the initiative design phase by: careful design, improvement of the quality of the any remaining waste at the construction site, and waste prevention at the building site (Hendriks, & Pietersen, 2000).

“Source reduction is most relevant to new construction and large renovation projects, as it involves reduced waste factors in materials, ordering, tighter contractors, and value engineering of building design and components” (Kibert, 2008, 448). “Careful design” would include, but not limited to, specification of materials which may easily be reused; modular design or prefabricated units that can be disassembled rather than demolished; purchasing materials fit for the job (not buying more than required); and provide adequate information on the materials used, and their maintenance. “Improvement of the quality of the any remaining waste at the construction site” would include separation of packaging, chemical waste, glass, plaster, aerated concrete and carpet remains; look for opportunities for reuse and any remaining material for other applications when possible; prevent the generation of highly polluting or toxic waste (asbestos, oil, paints, etc); and provision of easily reachable local recycling sites. “Waste prevention at the building site” would include choosing suppliers that uses reusable packaging and provide clean, well-organized and proper storage facilities to protect materials against water, dirt, and damage. “A construction process involves many different parties, all displaying unique expertise with respect to the building phase outlined. All parties in the construction process should assist to prevent and limit the generation of construction waste” (Hendriks, & Pietersen, 2000, 6).

## **Composting Regulation**

From the literature reviewed, cities can also benefit from a composting program and/or education about home composting. Yard trimmings and food residuals together constitute 24 percent of the U.S. municipal solid waste stream (EPA: Office of Solid Waste and Emergency Response, 1994). Ultimately, a significantly amount of food and yard waste is being sent to landfills when it potentially can contribute to environmentally benfical compost.

Composing is the biological process for converting organic solid wastes into a stable, humus-like product whose main use is a soil conditioner under controlled conditions. The phrase “decomposition” is used other than “stabilization”, because when practical usage is applied, the overall process rarely is carried out to the point where waste is completely stabilized. “In fact, the cut-off point may at times be short of “temporary stabilization” (Golueke 1997, 13).

The theory of composting is a body of knowledge based on repeated and refined experimentation and observation. The basic idea of composting is to try to speed up the processes of aerobic microbial transformation of substrate which originate from organic compounds for two main reasons. The first reason is the ““process-oriented composting’ we want to get rid of organic wastes, residues, and by-products. Volume and weight is reduced but emissions are not taken into consideration” (Gajdos 1997, 7). The second reason is the ““product-oriented composting’. We want to utilize organic wastes, residues or by-products, and even fuel crops, as raw material to manufacture useful products. “Plant nutrients will be recycled; energy saved and used again, pathogens, seeds inactivated, and pollution avoided” (Gajdos 1997, 7).

“An important first step for public officials considering a composting program is to determine what they want the program to achieve” (EPA: Office of Solid Waste and Emergency Response, 1994, 11) Specific goals of a composting program would include reducing the flow of materials into landfills or combustors; diverting certain types of materials from the MSW stream; complying with state or local regulations or recovery goals; and providing a practical management option for a single community or a larger region (EPA: Office of Solid Waste and Emergency Response, 1994). Once goals are created, it will be easier to evaluate technologies

and determine the role composting will play in the community's or city's overall management strategy.

## **Source Reduction**

“Source reduction includes product changes, source control, input material changes, technology changes, and good operating practices” (A&WMA Specialty Conference, 1988). There are several benefits that are related to source reduction and reuse. It saves natural resources by reusing materials and reducing waste affects communities, businesses, schools, and individual consumers economically.

There are four sample areas of concentration in material reduction that is represented in “*Designing Products and Programs for Solid Waste Minimization*” created by the Air & Waste Management Association. The first is refill pouches. The refill pouches are plastic film pouches containing concentrated liquid, which are filled into large reusable containers. By using this method, 85 percent in the volume of materials is accomplished. An example of the type of liquids that would be used includes fabric softener and liquid detergents.

The second material reduction is through liquid and powder concentrates, which can reduce the size of a packaged product to one third through one fourth of its former size, that is, 67 to 75 percent reduction in the volume of materials used to deliver the same results in performance of the product. The third area is Brick Packs. Ground coffee commonly packed in metal cans and plastic lids are being replaced by flexible foil (Fox, 1990). Replacing current coffee packaging with the flexible foil alternative, results in an 80 percent reduction in the volume. This method is currently utilized by Folgers ground coffee. The fourth method is thin diapers. Ultra-thin diapers have permitted a 50 percent reduction in the volume of materials used for diapers such as Luvs and Pampers. The four different methods that are set forth by Fox are only the start to a variety of ways to reduce waste.

The examples given above are only the start to a variety of ways to reduce waste. In order to reach a higher level of source reduction it will have to include a great level of support from many municipalities and the federal government. This task will also take a great deal of creativity and cooperation from packaging companies.

According to the EPA, between 1960 and 2008 the amount of waste each person creates has almost doubled from 2.7 to 4.5 pounds per day. The most effective way to stop this trend is by preventing the amount of waste that is created ... also known as source reduction. Source reduction is defined by the EPA as the practice of designing, manufacturing, purchasing, or using materials in ways that reduce the amount or toxicity of trash created. Another type of source reduction is reuse or reusing items to prolong that items entry in the disposal system. By reducing waste at its source, it prevents ongoing costs of waste disposal and the costs that recycling, composting, land filling, and combustion occurs. An important factor to source reduction is selecting less hazardous items such as cleaning products and pesticides and using the smallest amount necessary, which reduces waste toxicity.

There are more than 7,000 communities that have integrated “pay-as-you-throw as a part of source reduction. The “pay-as-you-throw” programs are programs where residents pay for each can or bin of garbage that they set out. By implementing these programs, citizens are consciously aware of the amount of trash of which they dispose. By disposing of less trash the residents have lower trash bills. Businesses and manufacturers may have an economic advantage by using less packaging materials. This source reduction practices allows businesses to purchase less raw materials lowering their manufacturing cost, therefore, increasing profit that is passed on to the consumer. Consumers also have an economic advantage by purchasing items in bulk that are packaged with less material or are reusable (EPA: Pay-As-You-Throw, 2009).

The most recent data for source reduction and reuse is from the year 2000. During this year more than 55 tons of Municipal Solid Waste was source reduced in the United States. This includes containers and packaging that represented around 28 percent of the materials that were sourced reduced; 17 percent is from nondurable goods such as newspapers and clothing; 10

percent is durable goods such as appliances, tires, and furniture; and 45 percent was due to other MSW like yard trimmings, and food scraps.

## **Chapter 3 - Methodology**

The following research studies the way Chicago is implementing ‘green’ solid waste management to determine if Chicago may be considered the prototype for sustainable solid waste management in cities across America. The city of Chicago was chosen over other cities based on the other ways the city is enforcing sustainability. During his administration, Mayor Daley has made it law that every city building constructed has to be Leadership in Energy and Environmental Design (LEED) certified. The City of Chicago Department of Environment (DOE) and the State of Illinois partnered to develop the Calumet Environmental Center (FCEC). The center is located in the Calumet area of Chicago and its purpose is to educate the public about the industrial, cultural and ecological heritage of the Calumet area. The Center also provides an operation base for research activities, volunteer stewardship, environmental remediation and ecological rehabilitation (University of Chicago,2009).

Chicago implements energy policies and initiative to ensure clean affordable and reliable energy for the city’s future. “Chicago’s Energy Plan sets specific targets for energy production and use, and identifies principles to guide the City of Chicago in responding to energy plans and proposals originating in Washington and Springfield” (Anthony, 2010, page 20). The City of Chicago implements many initiative and programs directed solely towards environmental sustainability. One of these programs includes the Chicago Brownfields Initiative which acquires, assembles and rehabilitates properties, and returns them to productive use. “The Initiative links environmental restoration with economic development by cleaning up and redeveloping brownfields and by improving policies to promote private redevelopment of brownfields” (City of Chicago: Chicago Brownfields Initiative, 2010, para 1).

Chicago is well-rounded in its programs to handle environmental sustainability from green buildings and homes, to restoration of brownfields, to programs that strongly promotes the use of Compact Fluorescent (CFL) Blubs. This environmental friendly mentality of the city has also been carried out through its waste management. “Residential solid waste and recycling literally are intertwined in the city of Chicago. With the start of the blue bag program in December 1995, the city ushered in a new type of commingled collection system for recyclables: using blue bags for recyclable materials that are collected weekly alongside solid waste” (White, 2001, para 4).

The following methodology evaluates the sustainability of Chicago's Solid Waste Management by creating a score sheet that was developed from the literature review written. The idea of creating a score sheet derived from the study of the America's Infrastructure Report Card. “The Report Card depicts the condition and performance of the nation’s infrastructure in the familiar form of a school report card—assigning letter grades that are based on physical condition and needed fiscal investments for improvement” (American Society of Civil Engineers, para 1) .The evaluation of Chicago’s current practices is limited to policy and procedures and availability of residential recycling, construction and demolition, composting and source reduction.

Sustainable Solid Waste Management includes the reduction of cities sole use of landfills and incineration to dispose of their solid waste. An overall systematic approach is desirable in order for the city to reduce solid waste. Focusing on key variables can create a score sheet measuring whether or not a cities solid waste management is successful (Table 3.1).

**Table 3.2: Sample Score Sheet**

Variables	Justification	Score
Government Policy	Through the literature review, it is commonly suggested that in order to have success in this matter the city will have to take control and set the standards (Feiock & West 1993)	6 points
Waste Reduction	The reduction of waste overtime concludes whether or not a city is implementing the correct programs and regulations in the quest for a more sustainable environment (Dernbach 2002)	6 points
Degree of Participation	Recycling turns materials that would otherwise become waste into valuable resources. Collecting used bottles, cans, and newspapers and taking them to the curb or to a collection facility is just the first in a series of steps that generates a host of financial, environmental, and social returns (EPA,2008)	5 points
Construction and Demolition Policy	C&D waste is considered to be one of the priority waste streams and appropriate actions need to be taken with respect to its effective management (Kourmpanis, 2008)	5 points
Composting Availability	Yard trimmings and food residuals together constitute 24 percent of the U.S. municipal solid waste stream. That's a lot of waste to send to landfills when it could become useful and environmentally beneficial compost (EPA, 2008)	4 points
Source Reduction	Perhaps if the reduction of waste isn't left up to the individual household, but is seen as an entirely separate system as Sustainable Solid Waste Management, then the quest for the reduction of waste and land fill dependency will decrease (Environmental Protection Agency, 2008)	5 points
Total		34 points

### **Sustainability Factors**

Through the literature review, six different factors have been chosen as bases for the score sheet created. The research conducted focuses on the years between 1990 through 2000, then 2000 through 2009. 1990 was chosen as the base year for it was the first year since the EPA stopped enforcing the 'state plan' and set new standards pertaining to SWM.

A significant amount of quantitative and qualitative information has been provided by the Chicago's Recycling Coalition. The coalition was created in the 1980's as the Coalition for Appropriate Waste Disposal. One of the main initial efforts of the organization was advocating for a landfill moratorium in Chicago, which was passed by City Council in 1984 and is still in effect. The Chicago Recycling Coalition was also responsible for shutting down Chicago's last municipal waste incinerator in the mid-nineties.



The coalition has made other significant environmental changes in Chicago's community. "For the media, we are regularly contacted as a reliable source of recycling history, political insights, and hard facts" (Chicago Recycling Coalition, 2006, para 5).

I visited the city of Chicago on October 2, 2009 to October 3, 2009 to observe the pick up process of the recycle bins, as well as observed different aspects of the recycling program. I was greeted by Rosa Sanchez, an employee at the Chicago's Department of Streets and Sanitation. Sanchez was able to provide a great deal of the city's day to day operations that occurs in the administrative side of the department. I was also able to go into the field with Ms. Sanchez and another employee of the streets and sanitation department. I observed the satellite office in the second ward of Chicago. I was taken to one of fifteenth recycling drop off boxes located throughout the city. While in the field, I was able to observe the collection of the "black bins" that contain regular consumer waste. I was unable to view the collection of the "blue bins" dedicated to recycling and yard waste, for they already picked up separately earlier in the week. I was not allowed to tour the separation facilities personally; however I was able to view the Waste Management Company videos of the process that is posted on their website.

### ***Criteria for Grading***

The factors are basic "yes" or "no" questions as it pertains to the city's government regulations; waste reduction; construction and demolition recycling polices; composting regulation; and availability and the city's outlook on source reduction. When there is only one question asked the value of that question holds a weight of one point. If there is more than one question asked, there is one point issued for each question.

The first factor concentrates on past and current "Government Regulations". In order to measure Chicago's compliance with this government policy factor, a collection of qualitative data was obtained from the City of Chicago's website, the Environmental Protection Agency and the Chicago's Recycling Coalition. It has been stated in the literature review that government regulations are important when enforcing sustainable practices. Table 3.2 illustrates the factors for government regulations.

**Table 3.3: Criteria for Government Regulations**

Criteria	Points
Has the city itself put forth any type of regulation to reduce the amount of waste going to landfills since 1990?	1 point
Have regulations been updated, changed, or created between the years 1990 and 2000? (One point if updated or changed to conform to changing needs, and one point for creation of new regulations)	2 points
Have regulations been updated, changed, or created between the years 2000 and 2009? (One point if updated or changed to conform to changing needs, and one point for creation of new regulations)	2 points
Is there a law in place that enforces consequences to households that do not recycle?	1 point

“Waste Reduction” overall is the second factor to determine was sustainability. Reduction is important to measure in order to determine if the city has attempted to recycle in the past and the success rate achieved. Reduction also includes whether or not the city is continually pressing towards successful citywide recycling. This is quantitative data that was collected from the Chicago’s Recycling Coalition Site and the City of Chicago website for both these sites have the information about the recycling programs, charts, and rates. The points for this variable will be distributed based on the factors in Table 3.3. The factors are basic “yes” or “no” questions about the city’s practices in waste reduction.

**Table 3.4: Criteria for Waste Reduction**

Criteria	Points
Is there a standard for the percentage of the city-generated waste is recycled?	1 point
Is the city meeting the goals that they have set forth? If no regulation exists, is the city meeting the recycling goal set forth by the EPA (As of 2008)? (one point for meeting city's goal and one point for meeting EPA's goals)	2 points
Has there been a recycling program implemented between the years 1990 through 2000? Was the program successful to the city? (one point for recycling program, one point if the city is reaching recycling goals)	2 points
Has the city experience a decrease in waste sent to landfills between 2000 and 2009?	1 points

The third factor to determine waste sustainability is “Recycling Degree of Participation”. If there are rules and regulations and opportunities in place, are the citizens taking advantage of those and how. Also this variable looks at how many households are participating in the recycling program. The degree of participation is based on qualitative data collected from the Department of Streets and Sanitation and based on personal observation. The points for this factor will be distributed based on the criteria in Table 3.4.

**Table 3.5: Factors for Recycling Degree of Participation**

<b>Factors</b>	<b>Points</b>
Does the recycling pick up program (if any) services the entire city? If not, are there plans in place to eventually do so? (if the program covers the entire city, both points will be granted, one point total if only plans exists)	2 points
Of the households serviced by the recycling program (if any), what is the percentage of households actively participating in the program? (participation is a key factor to a successful recycling program, minimum of 50% of participation out of the level of service is required)	1 points
Are there other opportunities for residents to recycle other than or in addition to, a recycling pick up program?	1 points
Dose the city offer proper education to its residents? (Without proper education, residents may not recycle properly or may not know the benefits and opportunities to recycle)	1 points

The fourth factor is directed towards “Construction and Demolition Recycling”. Government regulation on major construction and demolition is important to review for C&D waste constitutes 25 percent of landfill waste. The points for this variable will be distributed based on the factors in Table 3.5. The factors are basic “yes” or “no” questions about the city’s regulations and results of construction and demolition recycling.

**Table 3.6: Factors for Construction and Demolition Recycling**

Criteria	Points
Are there regulations controlling the amount of C&D debris that is going to landfills?	1 point
Does different type of construction have to comply with a certain amount waste recycled on the site? (i.e. construction, one point, demolition, one point, renovation, one point)	3 point
Is the city providing assistance and education to contractors so the maximum recycling results on site are achieved?	1 point

The fifth factor measured in Chicago will be regarding the city’s ability to provide a composting site for its residences and its regulations on composting. This is quantitative data that was collected from the Chicago’s Recycling Coalition Site and the City of Chicago. Points awarded will be based on personal observation, and will be distributed based on the factors in Table 3.6. The factors are basic “yes” or “no” questions about the city’s opportunities and regulation on composting.

**Table 3.7: Factors for Composting Regulation**

Criteria	Points
Does the city offer the opportunity for residents to participate or contribute to composting that is facilitated by the city?	1 point
Does the city offer education on the importance of and how to do home composting?	1 point
Is the city diverting 24% of its overall waste that would be considered composting material from becoming land filled? (Between 14-23 percent is awarded .5 points)	1 point
Are there regulations in place that prohibits residents from mixing composting material with regular municipal waste (i.e. yard waste, grass clippings, etc)	1 point

The last factor measured is the city’s policy and procedures that are directed towards “Source Reduction”. Minimizing the amount of waste that is produced during the beginning stages may reduce the average amount of waste that is produced per person per day. This is qualitative data that was collected from the Chicago’s Recycling Coalition Site, the City of Chicago and the State of Illinois. The points for this variable will be distributed based on the factors in Table 3.7.

**Table 3.8: Factors of source reduction**

<b>Criteria</b>	<b>Points</b>
Is the total waste generation steadily decreasing between 1990 to 2000?	1 point
Is the total waste generation steadily decreasing from 2000 to 2009	1 point
Does the city and/or state have regulations on the reduction of manufactured items? (one point awarded for the city, one point award for the state)	2 points
Is the city enforcing” pay-as-you-throw” programs to promote less waste that its residents might generate?	1 point

## **Limitations**

In conducting the research of Sustainable Solid Waste Management there are several limitations that are presented which includes: the analysis being conducted only by a single individual; there is missing data for the current year of 2009; the lack of data for total generated waste; and the analysis in this study has only been measured to one city.

The analysis conducted and the conclusion reached is a type of limitation because there is only one individual that is able to give a report on the data given. If there were various people analyzing the data, a consensus might be possible regarding whether or not Chicago should be considered as a prototype city for sustainable waste management. Because the score sheet layout was influenced from the Report Card of the America's Infrastructure, having different entities view the data may enhance the merit of this report.

Another limitation to the outcome of the research is the missing output data from the 2009 recycling results, which is not complete as of this writing. The data from the recycling of Chicago that has been reported for 2009 is only to the month of June. Having all of the completed data for 2009 may have resulted in giving the section of waste reduction a higher rating. Also, the total waste generated data collected was only from the years 1998 through 2007, therefore, a conclusion cannot be made for the generation of waste between the years 1990 and 2000.

The outcome of this report will have stronger merit if the City is measured to another city to see what the difference and a likeness they share against the score sheet developed through the literature review. Multiple cities would have presented the opportunity to compare results clarifying the soundness of the score sheet as well. Though the research conducted does have some limitations that does not mean that the research and conclusions presented is not valid.

## **Chapter 4 - Results for the City of Chicago**

### **Government Policies and Procedures**

Evaluating current government policy requires a review of previous regulations and the steps taken towards the future of waste sustainability. In the research conducted Chicago's efforts of sustainability begun in 1975 when the city's oldest multi-purpose recycling center, The Resource, was established by community activist, Ken Dunn. Dunn's first efforts of recycling and reuse work started in 1967-8, with pick up and drop off services in the Woodlawn and Hyde Park areas. After the center was founded, it expanded its efforts by establishing the Uptown Recycling Center to serve the north side of the city (The Resource Center, 2009).

In 1986, the Illinois Solid Waste Management Act (415 ILCS 20) was passed, administered by the Department of Energy and Natural Resources (IDENR). The purpose of this act was to establish a waste management hierarchy for the state of Illinois with waste reduction as the main priority, followed by recycling and reuse, combustion for volume reduction and land filling as the last option. "The legislation also creates a source of funding to promote recycling at a local level and mandates that certain state agencies set up recycling programs and purchase recycled products" (Chicago Recycling Coalition: Chicago Recycling Timeline, 2009, para 7 ).

It wasn't until 1988 when recycling goals for all counties in the state were created under the Illinois Solid Waste Planning and Recycling Act (415 ILCS 15). The act mandated that each county, or sector, with more than 100,000 residents or cities with more than 1,000,000 residents, had to submit a Solid Waste Plan by 1991 and reach 25 percent recycling goal by 1996. The Illinois EPA also issued grants to help in the development of the plans administered by this Act.

In January 1995, The Chicago High Density and Commercial Source Reduction and Recycling Ordinance was passed. The ordinance instituted a mandate that larger apartment buildings (more than 4 flats), office buildings, offices, and companies set up recycling programs with private haulers; all entities mentioned were not served by the Streets Sanitation trucks. Therefore, landlord or management companies are responsible for setting up recycling services

for residential buildings. Commercial establishments' contract directly for their waste hauling therefore, they are also responsible for setting up recycling for those renting a space in a building as part of the lease agreement. The start of the blue bags, mixed with residential garbage, were hauled by Streets and Sanitation trucks and taken to the four designated sorting stations, managed and operated by Waste Management (WMX). By December 1995, the City of Chicago's recycling rate was only at 5 percent.

In the summer of 1996, the city ceased operation of the Northwest incinerator. Also during this time the city was unable to separate out enough commodities (paper, metals, etc) and segregated yard waste in order to reach Illinois's 25 percent recycling goal. Therefore, the city's sorting facilities began to generate a new material called "screened yard waste". "Screen Yard Waste" included raw garbage and loose yard clippings pressed together through the use of screens that produced matter that was land-applied. Ultimately this matter was used as daily cover on local landfills.

The city had also begun a small pilot program in the 19<sup>th</sup> ward in 2005. The pilot program included two bins, one for recyclables, and one for garbage which were placed behind each residence. Two different trucks collected each bin and hauled the recyclables to a dedicated recycling facility. This is the type of program that the Chicago Recycling Coalition has been trying to implement for the last ten years and continued to work for its expansion to all neighborhoods throughout the city. Also in 2005 the Chicago City Council passed an ordinance that banned the expansion or siting of new landfills within the city limits for the next 20 years.

The Blue Bag Program was the leading recycling program in Chicago for 16 years; however on May 2<sup>nd</sup>, 2008 the City of Chicago announced the end of the Blue Bag and replaced the program with source-separated recycling, thus the Blue Cart program was established.



### ***Government Regulation Results***

Chicago implemented the Blue Bag Program in 1992 and the Blue Cart program in 2008 to reduce the amount of waste going into the landfill. Also in 2005, the Chicago City council passed an ordinance that banned the expansion and siting of new landfills for the next twenty years. Thus, Chicago receives one point for the first factor of regulations to reduce the amount of waste going into landfills.

In January 1995, The Chicago High Density and Commercial Source Reduction and Recycling Ordinance were passed. This ordinance mandated that larger apartment buildings (more than 4 flats), office buildings, offices, and companies set up recycling programs with private haulers; all entities mentioned are not serviced by the Streets Sanitation trucks. In 1996, the city implemented “Screen Yard Waste” which included screening raw garbage and loose yard clippings to use as composting to reach Illinois’s 25 percent recycling goal. Thus, the City of Chicago receives two points for the creation of new sustainable regulations, including the creation of the Blue Bag program, between the years 1990 through 2000.

In 2005, the Chicago City Council passed an ordinance that banned the expansion or siting of new landfills within the city limits for the next 20 years. After the passing of the ordinance, in 2006 the City of Chicago announces the phasing out of the blue bag program, replacing it with source-separated recycling, thus The Blue Cart Program was established. The city of Chicago receives two points for the creation of a sustainable regulation and updating the recycling program between the years 2000 through 2009.

On January 1, 1995, the City passed a law stating that all businesses and residential buildings that contract for waste hauling services must recycle. The law also sets forth penalties for not complying with the law. If the Department of Environment or Department of Streets and Sanitation determine that an establishment is making no effort to recycle, it has the authority to issue fines and to revoke a business license. Because of Chicago’s regulation on penalties for failure to recycle the city receives one point for the last factor. Overall, the city has received all six points available in the Government and Regulation factors.

**Table 4.1: Government Regulation results**

Criteria	Points
Has the city itself put forth any type of regulation to reduce the amount of waste going to landfills since 1990?	1 point
Have regulations been updated, changed, or created between the years 1990 and 2000? (One point if updated or changed to conform to changing needs, and one point for creation of new regulations)	2 points
Have regulations been updated, changed, or created between the years 2000 and 2009? (One point if updated or changed to conform to changing needs, and one point for creation of new regulations)	2 points
Is there a law in place that enforces consequences to households that do not recycle?	1 point

### **Waste Reduction Overall**

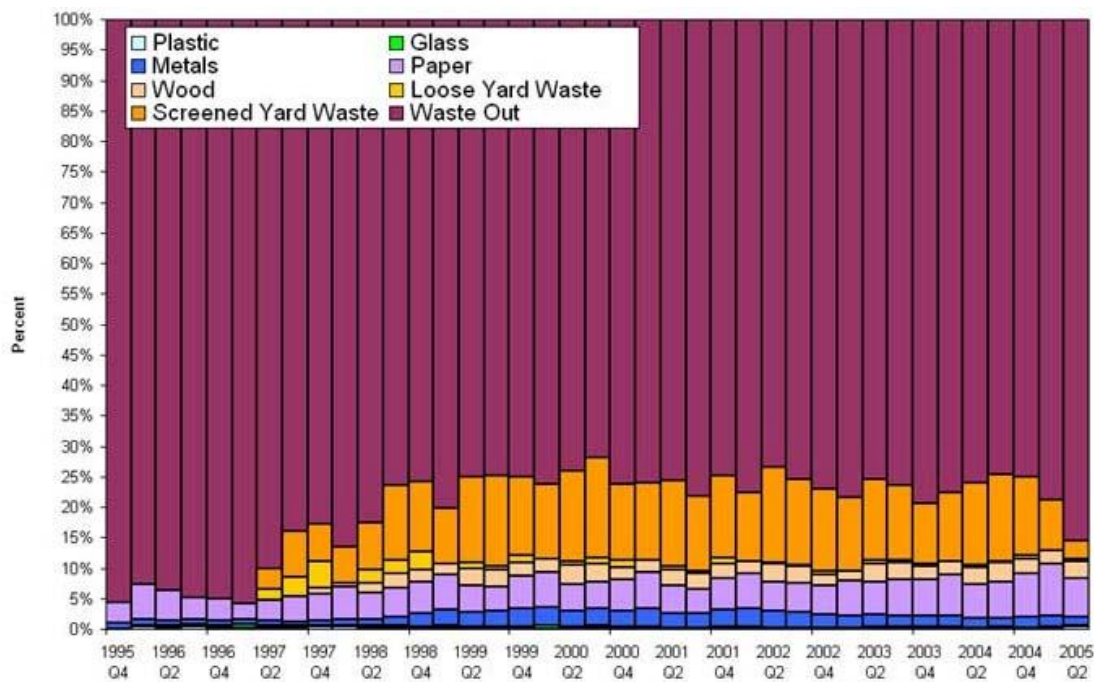
In 1988, the state of Illinois passed a law that 25 percent of the city's waste was required to be diverted from landfills. The citizens of Chicago were asked to participate in the City's blue bag recycling program initiated by Mayor Daley, starting in December 1995. The program was to attempt to divert 25 percent of materials from landfills to meet the requirements of the state law.

Since the start of the Blue Bag Program in the mid-nineties, several million dollars were spent in educational campaigns. However, only 12 to 24 percent of households participated out of the 94 percent of Chicagoans that knew of the program. The program was set so that the households would have to wash, sort, and store recycled materials every week to only have everything mixed in with garbage trucks. The Chicago Recycling Coalition received monthly reports from the city since the inception of the blue bag program. The monthly reports included weights from the four sorting facilities and the breakdowns and weights of all recycled materials, as well as garbage that went to the landfill.

During the first two years of the program, the recycling rates were only around 5 to 6 percent. Through 2004, the recycling rates increased just below 10 percent (Figure 4.1) In the ten years the blue bag program was in operation, it successfully diverted more than 2 million tons of recyclable waste from landfills. However, different measures had to be taken due to changes in technology and recycling procedure; changes must occur in order to have a higher rate in the amount of participation and total materials recycled.

In replace of the Blue Bag program the Blue Cart program was implemented. Because of this program, the city no longer paid sorting center operators to run the machinery that sorted recyclables out of the waste stream; however, the operator is still required under permit to recycle blue bags.

**Figure 4.1: Blue bag results percentage (Chicago Recycling Coalition, 2008)**



The Blue Cart program consisted of giving a cart to those households which were located in a Blue Cart area. The cart is for depositing recyclable materials including paper, cardboard, plastics, glass, tin, and aluminum. Materials placed in the cart can be loose or bagged, and there is no prior preparation or sorting needed before placing recyclables in the cart itself. The carts are then emptied by the Department of Streets and Sanitation (Figure 4.2).

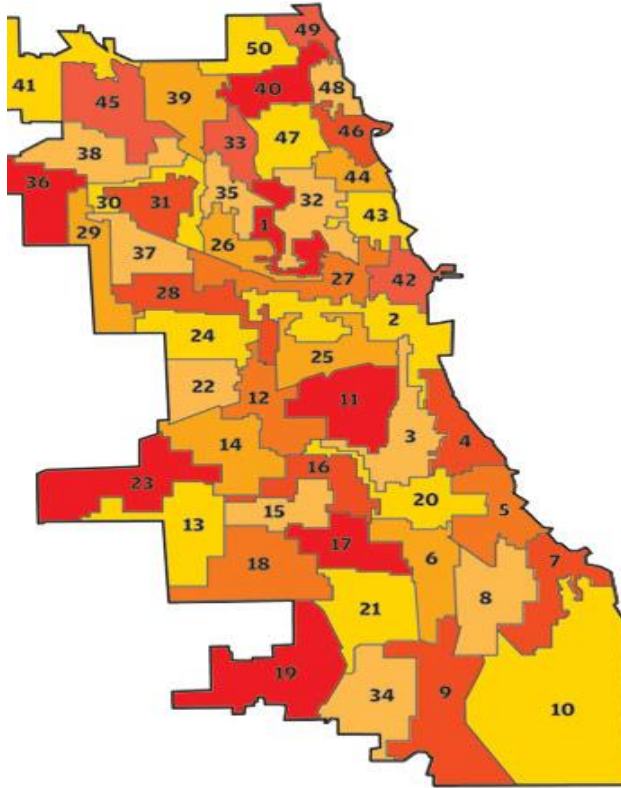
**Figure 4.2: Blue Cart pick-up (Chicago Recycling Coalition, 2009)**



Households that are located in a Blue Cart area also have the option to participate in yard waste picked up and recycle. The yard waste (such as: grass clippings, leaves, weeds, etc.) must be placed in paper (preferred) or plastic bags next to the Blue Carts. Yard waste is also picked up separately from the garbage and taken to a composting facility through a composting process; the organic matter decomposes into a nutrient rich soil additive that can be used as a natural fertilizer.

The data collected from the Blue Cart program only focuses on the wards serviced during the given year. In 2007, the Blue Carts only covered the 1<sup>st</sup>, 5<sup>th</sup>, 8<sup>th</sup>, 19<sup>th</sup>, 37<sup>th</sup>, 46<sup>th</sup>, and 47<sup>th</sup> ward. In 2008, the Blue Cart services expanded to parts of the 6<sup>th</sup>, 9<sup>th</sup>, and 20<sup>th</sup> wards known as the Southeast Region. It also covered portions of the 32<sup>nd</sup>, 33<sup>rd</sup>, 40<sup>th</sup>, 44<sup>th</sup>, 46<sup>th</sup>, 47, and 48<sup>th</sup> wards known as the Northeast Region and the Southwest Region that included portions of the 13<sup>th</sup>, 14<sup>th</sup>, 18<sup>th</sup>, and 23<sup>rd</sup> wards (Figure 4.3). As of June 2009, the Blue Cart has not increased to include any additional wards.

**Figure 4.3: Chicago wards (Chicago Reader, 2011)**



The Blue Cart results in 2007 equaled 13.30% recycled out of 82,029.47 tons of garbage collected. The yard waste percentage of that was 4.36% recycled. In total, the amount recycled in 2007 was 17.66% of all garbage collected. In 2008, the amount of garbage increased 101% due to the increase of wards serviced. The Blue Cart recycling was 14.36% out of 165,474.85 tons of garbage collected and a total of 17.18% overall recycled (Table 4.2).

**Table 4.2: Blue Cart Results 2007 and 2008**

Year	Ward	Refuse (in tons)	Blue Cart materials (in tons)	Yard Wastes (in tons)	Total (in tons)	Blue Cart Recycling %	Yard Waste %	Total Recycling
2007	Total	82,029.47	13,244.89	4,347.61	99,621.97	13.30%	4.36%	17.66%
2008	Total	165,474.8	28,698.13	5,631.90	199,804.88	14.36%	2.82%	17.18%

\*Yard waste was collected until the first major snowfall, December 6, 2007 (City of Chicago, 2007, 2008)

**Table 4.3: Blue Cart results 2009**

Year	Ward	Refuse (in tons)	Blue Cart materials (in tons)	Yard Wastes (in tons)	Total (in tons)	Blue Cart Recycling %	Yard Waste %	Total Recycling
2009	Total	140,739.99	22,752.24	1,547.23	165,039.46	13.79%	0.94%	14.72%

\*2009 data is only till the month of June (City of Chicago, 2009)

### ***Waste Reduction Results***

In 1988, the state of Illinois passed a law that 25 percent of the city's waste was required to be diverted from landfills. The standard currently still applies. Therefore, the city receives one point for the first factor. However, the city is not currently reaching its goal of recycling 25 percent of its generated waste. The Blue Bag recycling program was implemented in 1995 and ended in 2008 and according to the City of Chicago, the program was not a success therefore, no points will be issued for factor two. Out of 95 percent of Chicagoans that knew of the program, only 12 to 24 percent of household participated. The city only receives one of the two points allowed in the third factor of waste reduction.

The Blue Cart Program was created in 2007 but didn't officially launch until 2008. The Blue Cart program has recycled around 17.50 percent in 2007 and 2008 compared to the 5 to 10 percent the Blue Bag programmed recycled each year for ten years. Therefore, the city has received both points for the implementation and success of a recycling program from 2000 through 2009. Overall the City of Chicago receives a total of four recount points out of seven points for the category of Waste Reduction (Table 4.4).

**Table 4.4: Chicago waste reduction over time results**

<b>Factors</b>	<b>Points</b>
Is there a standard for the percentage of the city-generated waste is recycled?	1 point
Is the city meeting the goals that they have set forth? If no regulation exists, is the city meeting the recycling goal set forth by the EPA? (As of 2008)	0 points
Has there been a recycling program implemented between the years 1990 through 2000? Was the program successful to the city?	1 points
Has there been a recycling program implemented between the years 2000 through 2009? Was the program successful to the city?	2 points

### **Degree of Participation**

The Blue Cart program serviced more than 84,000 households in 2007. The program did not officially start until June 2008 and will continue through 2011. In 2008, the program was expanded to include an additional 92,000 homes, bringing the total number of residents with Blue Cart service to 176,000. The Streets & Sanitation Commissioner Michael J. Picardi stated "We will continue on an accelerated expansion plan bringing the program to approximately 140,000 homes each year until the end of 2011 when the Blue Cart will be in place in all of the 600,000 homes serviced by Streets & Sanitation" (City of Chicago: City Shifting to Blue Cart Recycling by 2011, 2008, para 2). The program reaches out to those homes that received regular garbage pickup meaning single family home or buildings up to four units, or two flats (Figure 4.4).

Several meetings were conducted between the residents and the Department of Sanitation before the bins were placed in service. The meetings were meant to educate the neighborhoods about recycling, what to recycle, and to determine the probable degree of participation. Every household in the Blue Cart wards were given one black bin for garbage and a blue cart for recyclables. If one chooses, they can contact the Department of Streets and Sanitation to add another blue cart but not another black cart (Figure 4.5).



**Figure 4.4: Example of a two-falt building**  
(Picture by Kala Raglin, 2009)



**Figure 4.5: Dumping of black bins**  
(Picture by Kala Raglin, 2009)



The Blue Cart program was planned to roll out in phases or the city could face bankruptcy, therefore, the Blue Cart program services a certain number of wards. However, households that aren't in the Blue Cart districts are still able to recycle through the blue bag concept. As an alternative, drop off boxes are placed throughout the wards where residents may deposit their recyclables. There are a total of fifteen drop off boxes separated geographically throughout the entire city and according to the Department of Streets and Sanitation, the drops off boxes are filled to capacity each week (Figure: 4.6).

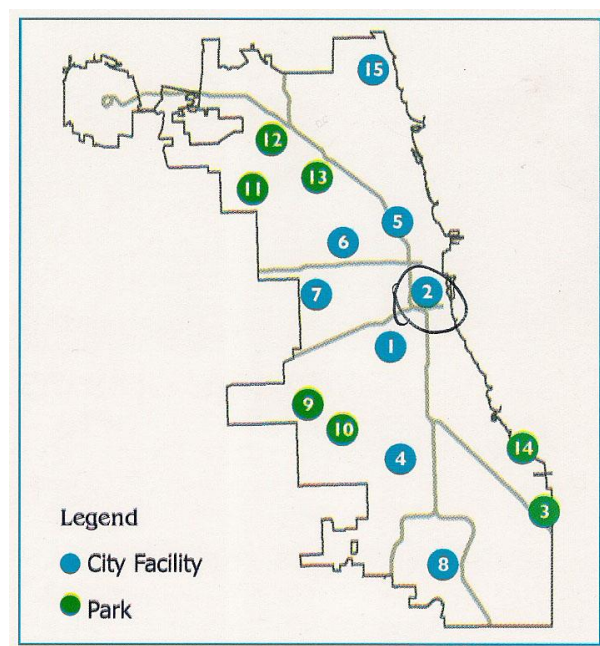
**Figure 4.6: Drop off boxes (Picture by Kala Raglin, 2009)**





Businesses who wish to recycle have to make arrangements with their private waste hauler to start a program. The multi-unit buildings (more than four units) may take their materials to one of the many drop-off boxes or can make arrangements with their private waste haulers to start a separate collection program (Figure 4.7). The City is currently working on a pilot program, just as they did with the Blue Carts, for multi-unit recycling to evaluate the best practices for multi-building recycling.

**Figure 4.7: Chicago wards with drop off boxes**  
(Chicago Department of Streets and Sanitation, 2009)



Currently the City of Chicago is subsidizing the cost of the Blue Cart program. “Part of the cost is offset by a savings of disposal because the recycled material[s] is not going to landfill. Additionally, some costs are offset because the sorting center that accepts the recyclables pays the City by weight for the material” (City of Chicago: Waste Reduction Programs, 2010, 1). In addition to the funding that is coming in, the Illinois Department of Commerce and Economic Opportunity is providing a four-year grant in the amount of \$8 million to partially fund the purchase of the carts.

### ***Degree of Participation Results***

Currently the Blue Cart program does not service the entire city for the city fears that if the program is implemented to every ward at once, bankruptcy would be on the horizon; however, the city's plans to extend the program throughout the entire city by the year 2011. Even though not every household is serviced by the Blue Cart program, they can still use the blue bag concept to recycle. Thus, the city receives two points two points for the first factor.

The Blue Cart program services 176,000 households. According to Ms. Sanchez of the Department of Streets and Sanitation, every household that is within the wards covered participates in the recycling program in some type of way. Most households even asked the city for an additional blue cart to the one already allotted to them. The high participation rate may be due to the fact the city only allows the residents to have a single black cart for solid waste and as many recycle bins as they need. Chicago receives the one point for the second factor.

The City has provided fifteen recycling drop off boxes throughout Chicago giving those an opportunity to recycle that aren't a part of the Blue Cart services. According to the Department of Streets and Sanitation, the drop off boxes are filled to capacity each week. Also, those that aren't serviced by the Blue Cart are still able to use the blue bag method to recycle. The City receives one point for the third factor of alternatives to the Blue Cart program.

The Department of Streets and Sanitation provides recycling education to the neighborhoods and local schools by holding meetings for the public to attend. Also, posted on the drop off boxes are instructions about what, where, and how to recycle different materials. The Streets and Sanitation Department also provides flyers for the residents about recycling, as well as providing detailed information about recycling in Chicago provided on the City of Chicago's website. Chicago receives the point for educating its citizens. Overall the City of Chicago receives a total of five points out of five points for the category of Degree of Participation (Table 4.5).

**Table 4.5: Chicago degree of participation results**

<b>Factors</b>	<b>Points</b>
Does the recycling program (if any) services the entire city? If not, are there plans in place to eventually do so? (if the program covers the entire city, both points will be granted)	2 point
Of the households serviced by the recycling program (if any), what is the percentage of households actively participating in the program? (participation is a key factor to a successful recycling program, 50% of participation out of the level of service is required)	1 point
Are there other opportunities for residents to recycle other than or in addition to, a recycling program?	1 point
Dose the city offer proper education to its residents? (Without proper education, residents may not recycle properly or may not know the benefits and opportunities to recycle)	1 point

### **Constructions and Demolition Regulations**

“The Department of Public Health promotes the responsible separation and recycling of construction and demolition debris to help contractors and individuals save on costly disposal fees while protecting the environment” (City of Chicago: Construction and Demolition Debris Recycling, 2010, para 1). As of 2005, the City of Chicago already created Construction or Demolition Site Waste Recycling Ordinance; however the City Council passed amendments to the current ordinance at that time. The changes were to increase the amount of C&D debris that is recycled in Chicago. Starting March 1, 2006, contractors applying for building and wrecking permits must keep track of how much waste is generated at their project sites and must strive to meet the recycling goals of the city. In 2006, an amendment of the ordinance occurred stating that a C&D site must reach a goal 25 percent of its materials recycled. On January 1, 2007, the required amount of recycled site C&D waste was increased from 25 percent to 50 percent. The City of Chicago Construction and Demolition Waste Ordinance is located in Appendix A.

The City of Chicago defines C&D Debris as a non-hazardous, non-contaminated solid waste resulting from construction, remodeling, and repair or demolition operation on pavement, buildings and other structures. Construction and demolition debris that can be recycled in Chicago is identified on the City of Chicago website including:

Bricks, concrete and other masonry materials  
Rock  
Wood, including non-hazardous painted, treated and coated wood  
Scrap metal  
Plaster  
Gypsum drywall  
Plumbing fixtures and piping  
Non-asbestos insulation  
Roofing shingles and over roof coverings  
Reclaimed asphalt pavement  
Glass  
Plastics Landscape waste

The City has provided a how –to outline to obtain maximum results to ensure that the C&D recycling is done correctly. Detail planning before starting a project is highly recommended. Apart of the planning process would include obtaining in depth knowledge of exact building materials that will be present at the construction or demolition site. Also involved in the planning stage is developing a plan of how the recyclables will be sorted at the construction site and the recycling entity that various contractors will utilize. The City also provides a best practices manual to assist contractors in C&D recycling.

### ***Construction and Demolition Results***

In 2006, the Construction or Demolition Site Waste Recycling Ordinance was changed stating that a C&D site must reach a goal of 25 percent of its materials recycled. On January 1, 2007, the required amount of recycled site C&D waste was increased from 25 percent to 50 percent. Because of this ordinance the City receives one point for the first factor. Starting March 1, 2006, contractors applying for building and wrecking permits (which includes renovation) must keep track of how much waste is generated at their project sites and must strive to meet the recycling goals of the city. The city receives three points for the second factor by having regulations for different working sites.

To ensure that the C&D recycling is done correctly the City has provided a how –to outline to obtain maximum results. The City also provides a best practices manual to assist contractors in C&D Recycling. Thus the city receives the points allowed in the final factor of Construction and Demolition. Overall the City of Chicago receives a total of five points out of five points for the category of Construction and Demolition.

**Table 4.6: Chicago construction and demolition results**

<b>Factors</b>	<b>Points</b>
Are there regulations controlling the amount of C&D debris that is going to landfills?	1 point
Does different type of construction have to comply with a certain amount waste recycled on the site? (i.e. construction, one point, demolition, one point, renovation, one point)	3 points
Is the city providing assistance and education to contractors so the maximum recycling results on site are achieved?	1 point

### **Composting Regulations and Availability**

The Chicago City Council passed an the Composting Ordinance in 2007 regulating small-scale compost operations, including those found in residential backyards. “Small-scale compost operations, as defined by the ordinance, are exempt from Chicago Department of Environment permit requirements” (City of Chicago: Composting Ordinance, 2009, para 1). The ordinance also states that these types of operations have to be well-managed, and an application must be completed prior to the expansion of a backyard composting operation.

The Composting Ordinance also prohibits activities that are the direct opposite of composting. The ordinance states that it is unlawful for any person to place, leave, dump, or permit to accumulate any garbage or trash in any building, structure or premises so that the same shall afford to food (for human consumption). The ordinance also states that any person, who violates this particular part of this ordinance, shall be liable to the city for three times the amount of all costs and expenses incurred by the city in abating a nuisance caused by the violation. The ordinance for composting passed by the City Council of Chicago can be found in Appendix B

In the summer of 1996, the city ceased operation of the Northwest incinerator. Also during this time the city was unable to separate out enough commodities (paper, metals, etc) and segregated yard waste in order to reach Illinois's 25 percent recycling goal. Therefore, the city's sorting facilities began to generate a new material called "screened yard waste". "Screen Yard Waste" included raw garbage and loose yard clippings pressed together through the use of screens that produced matter that was land-applied. Ultimately this matter was used as daily cover on local landfills.

Warren Ribley, director of the Illinois Department of Commerce and Economic Opportunity (DCEO) stated that "Composting is a cleaner, more economical way for large users like municipalities and restaurants to dispose of their food scraps" (Love, 2009, para 2). The DCEO conducted a study of composting entitled the *Illinois Commodity/Waste Generation and Characterization Study*, which revealed that food scraps are the single largest material category of municipal solid waste (MSW) landfilled in Illinois at 12 percent. Thus, the DCEO created The Food Scrap Composting Grant program that will assist entities with obtaining equipment for sustainable projects that will increase the long-term volume of organic material being composted in Illinois (Love, 2009)

### ***Composting Regulation Results***

Residents in the Blue Cart areas are able to place their composting materials (i.e. yard waste, grass clippings, etc.) next to their recycling bins and the waste is picked up by the city and becomes a part of the city's composting process. The City of Chicago receives one point for the first factor. The city offers support to composting by collecting compost materials along with the Blue Carts and also provides education through the use of a brochure created by the Department of Streets and Sanitation. Education about composting may also be obtained from the City of Chicago's website. Because of this education the city receives one point for the second factor.

Although the City offers chances to recycle compost waste and provides education to its residents, the City is still unable to recycle 24 percent of its generated composting waste. In 2007, the City only achieved 4.36 percent recycled and in 2008 2.82 percent. Therefore, Chicago will not receive a point for the third.

The ordinance states that it is unlawful for any person to place, leave, dump, or permit to accumulate any garbage or trash in any building, structure or premises so that the same shall afford to food (for human consumption). The ordinance also states that any person, who violates this particular part of this ordinance, shall be liable to the city for three times the amount of all costs and expenses incurred by the city in abating a nuisance caused by the violation. Therefore, Chicago receives one point for the remaining factor. Overall the, Chicago receives three out of the four points offered in composting regulation

**Table 4.7: Chicago composting regulation and availability results**

<b>Factors</b>	<b>Points</b>
Does the city offer the opportunity for residents to participate or contribute to composting that is facilitated by the city?	1 point
Does the city offer education on the importance of and how to do home composting?	1 point
Is the city diverting 24% of its overall waste that would be considered composting material from becoming land filled? (Between 14-23 percent is awarded .5 points)	0 point
Are there regulations in place that prohibits residents from mixing composting material with regular municipal waste (i.e. yard waste, grass clippings, etc)	1 point

## **Source Reduction**

In 1995, the City of Chicago passed the Chicago High Density Residential and Commercial Source Reduction and Recycling Ordinance. The ordinance affect residential and commercial operations that contracted with private waste collection companies. The ordinance purpose is to recover materials that would otherwise be thrown away, reducing the amount of waste generated in Chicago.

In 1986, the Illinois Solid Waste Management Act (415 ILCS 20) was passed, administered by the Department of Energy and Natural Resources (IDENR). The purposes of the act were to establish a waste management hierarchy for the state of Illinois with waste reduction as the main priority, followed by recycling and reuse, combustion for volume reduction and land filling was the last option. “The legislation also creates a source of funding to promote recycling at a local level and mandates that certain state agencies set up recycling programs and purchase recycled products” (Chicago Recycling Coalition: Chicago Recycling Timeline, 2009, para 9).

A successful waste reduction program, according to the City of Chicago is outlined with three key components. The first component is source separation of at least three recyclable materials; newspaper, glass, or plastic. Recyclable materials are then separated from other solid waste and kept separated until it can be recycled. “In special cases, a waste service can collect only two materials if the building also implements two waste reduction measures in the building or their office, such as using energy saving light bulbs and reusing supplies” (City of Chicago: Recycling in Commercial/Retail Spaces, 2010, para 3).

The second component requires each building must maintain a written recycling plan. At minimum the plan must address; the three recycled materials and any source reduction measures used by the landlord; how to prepare recyclables and what happens to them once the waste hauler picks them up; a summary of the education program; the contract with the hauler; and semi-annual waste hauler quality reports and any reports of contamination. The third component requires each building to implement an educational program that informs new residents and all residents annually how to use the buildings recycling program, what to recycled, and where to take it. All residents must be notified of any changes at least ten days before the changes occur.



Table 4.7 and graph 4.7 shows the generated waste for the city of Chicago from the year 1998 to the year 2007. The years from 1990 to 1997 were unavailable to include in this study. The percentage change is added to the table to show how much of a reduction or addition of waste was generated. In obtaining the percentage change, the total in year two (y2) is subtracted from the total in year one (y1) and divided by the total amount in year one (y1), then multiplied by 100 to get the percentage. The formula is as follows:

$$\text{Percentage change} = (y2) - (y1) / (y1) * 100$$

Thus, to find the overall percentage change of generated waste in Chicago between the year 2000 (y1) and 2007 (y2), the formula is as follows:

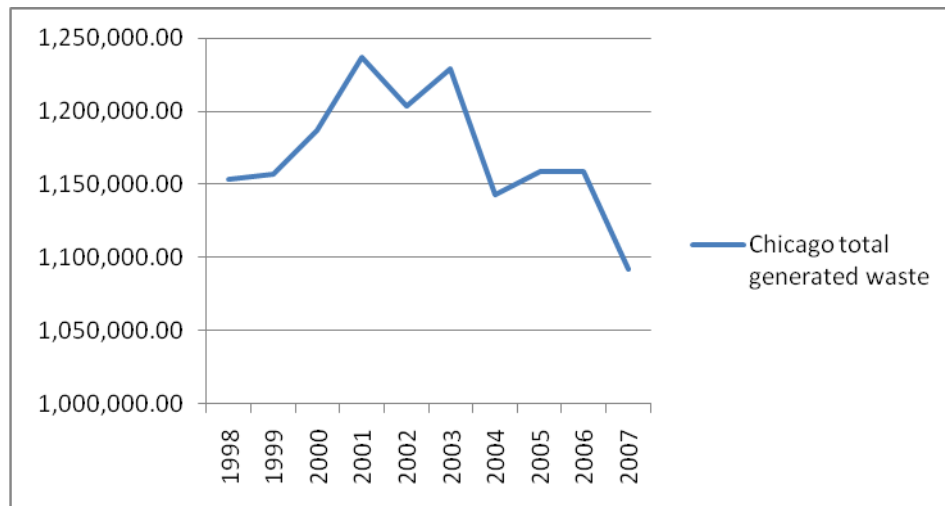
$$\begin{aligned} &= (1,187,061.26 - 1,091,582.57) / 1,091,582.57 * 100 \\ &= -8.04 \text{ percentage change} \end{aligned}$$

The -8.04 percentage change from the year 2000 to 2007 shows that the overall amount of waste that is generated has declined 8.04 percent from the year 2000 to 2007. Table 4.7 gives the number of total waste as well as the percentage change for each year. The percent that is shown in 2007 is the percentage change from 2000 to 2007. Figure 4.7 visually shows the decline and rise in the generated waste however, the total waste overall is declining given the numbers from 1998 to 2007.

**Table 4.8: Total generated waste City of Chicago 1998-2007**  
**(Chicago Department of Streets and Sanitation, 2009)**

Year	Amount of Waste Generated	Percentage Change
1998	1,153,590.70	
1999	1,156,821.48	0.28%
2000	1,187,061.26	2.61%
2001	1,237,139.09	4.22%
2002	1,203,720.03	-2.70%
2003	1,243,723.16	3.32%
2004	1,228,984.47	-1.19%
2005	1,143,069.79	-6.99%
2006	1,158,615.68	1.36%
2007	1,091,582.57	-8.04%

**Figure 4.8: Total waste generated in Chicago 1998-2000**  
**(Chicago Department of Streets and Sanitation, 2009)**



### ***Source Reduction Results***

The numbers available for this study are only total waste generated from 1998 to 2007. Thus, a conclusion cannot be drawn about the increase or decrease of total waste from the year 1990 to 2000. Chicago receives zero points for the first variable. However, the data given from 2000 to 2007 shows an overall decline in generated waste even though there are some years where waste increased and then decreased as shown in figure 4.7. Chicago receives one point for variable two of source reduction.

The City of Chicago, nor the State of Illinois, addresses the issue of source reduction of manufactured items only after the product is made. Chicago receives zero out of two points for the third factor. The last factor also receives zero points for not implementing a “pay as you throw” program for its residents. Overall Chicago receives one out of the five points offered for source reduction.

**Table 4.4: Chicago source reduction results**

<b>Factors</b>	<b>Points</b>
Is the total waste generation steadily decreasing between 1990 to 2000?	0 points
Is the total waste generation steadily decreasing from 2000 to 2009	1 point
Does the city and/or state have regulations on the reduction of manufactured items? (one point awarded for the city, one point award for the state)	0 points
Is the city enforcing” pay-as-you-throw” programs to promote less waste that its residents might generate?	0 points

## Chapter 5 - Conclusion

There were several limitations in this study that otherwise may have given more information that could have been applied during the scoring process. Limitations including: limited data, data collection was only dependent on one individual, the lack of data for total generated waste, and the analysis in this study is only restricted to one city. However, the outcome of the research shows positive as well as negative conclusions in Chicago's Solid Waste Management. The scoring results are represented in Table 5.1.

**Table 5.1: Chicago's overall results**

Variables	Justification	Score
Government Policy	Through the literature review, it is commonly suggested that in order to have success in this matter the city will have to take control and set the standards	6/6 points
Waste Reduction	The reduction of waste overtime concludes whether or not a city is implementing the correct programs and regulations in the quest for a more sustainable environment.	4/7 points
Degree of Participation	Recycling turns materials that would otherwise become waste into valuable resources. Collecting used bottles, cans, and newspapers and taking them to the curb or to a collection facility is just the first in a series of steps that generates a host of financial, environmental, and social returns (EPA,2008)	5/5 points
Construction and Demolition Policy	C&D waste is considered to be one of the priority waste streams and appropriate actions need to be taken with respect to its effective management (Kourmpanis, 2008)	5/5 points
Composting Availability	Yard trimmings and food residuals together constitute 24 percent of the U.S. municipal solid waste stream. That's a lot of waste to send to landfills when it could become useful and environmentally beneficial compost (EPA, 2008)	3/4 points
Source Reduction	Perhaps if the reduction of waste isn't left up to the individual household, but is seen as an entirely separate system as Sustainable Solid Waste Management, then the quest for the reduction of waste and land fill dependency will decrease	1/5 points
Total	After you make individual chart corrections rework these final numbers and the related text	24/33 points

In the developed sample score sheet for Sustainable Solid Waste Management, the City of Chicago has received a total of twenty-four points of the thirty-three points offered. Overall, the city scores 73 percent. The score sheet shows that Chicago has several beneficial sustainable practices in their overall waste management system, but also has room for improvement. Through the literature review, it can be concluded that government regulations are a strong advocate for recycling in individual cities, if not in entire states. By enforcing regulations such as ordinances and laws, the citizens of the city would be required to recycle their individual waste, which in turn may greatly reduce the total amount of waste generated overall.

In the category of Waste Reduction, Chicago is currently not reaching the recycling rates set forth by the State of Illinois and the Environmental Protection Agency. Chicago also fell short in the success of the first citywide recycling program; however the city has shown great improvement with the current Blue Cart recycling program. In 1995, recycling was encouraged among the residents of Chicago by introducing curbside recycling through the Blue Bag program. By 2008, recycling became a popular practice because of its convenience.

Though the residents had less of a responsibility in recycling by using the curbside program, it was still an inconvenience by making households clean, separate, and store recyclables only to be mixed with solid waste by the sanitation trucks. This inconvenience was reflected in the amount of participation Chicago received in the Blue Bag Program. It wasn't until the Blue Cart Program, that the city saw an explosion in the participation of residents in the effort to recycle. The Blue Cart offered a more convenient way of recycling by placing recyclables in its respectable bins. It can be concluded through the study of Chicago's failed attempt in the Blue Bag Program and the success of the Blue Cart Program that curbside recycling, with less responsibility to the resident as possible, is an effective way to reduce overall generated waste.

In order to strengthen the recycling participation, Chicago may benefit from aggressive education of not only the benefits of recycling but also the current, as well as future, issues that the city and the nation are facing. Also provided in the education, Chicago may include the current statistics and the goals the city is hoping to achieve going forward. Local supermarkets and businesses are great places to educate by supplying information about items that are used with recycle materials, environmentally safe products, and providing recycling opportunities in the store its self for newspapers, aluminum cans, and plastic bags. By educating the residents of the larger issue at hand, such as the decreasing amount of landfill space available, may put in perspective the importance of recycling. Placing information booths, posters, and billboards, the residents are consistently reminded and educated may also boost participation.

Chicago is effectively reducing the amount of Construction and Demolition waste stream that are placed in landfills. The success of reducing C&D waste is credited to the regulations the government placed on new construction, demolition, and renovation sites. Starting in 2006, contractors applying for building and wrecking permits are required to keep track of the amount of waste that is generated at their project sites and must strive to meet the recycling goals of the city. The success of Chicago's reduction in C&D waste occurred when an amendment of the ordinance changed from the previous goal of 25 percent to 50 percent of total materials recycled. Given to the success rate, Chicago may consider increasing the goal percentage each year as recycling technology and efficiency increases.

The city offers an alternative to composting by collecting yard trimmings and other composting materials during recycling collection days with no cost to the residents. By making it against the law to mix compost materials with solid waste, increases Chicago's chances at reducing the amount of composting materials being landfilled. On-the-other-hand, the city also lost points for not effectively diverting 24 percent of its compost materials from being landfilled. The Blue Cart Program currently does not cover the entire Chicago area, which could explain the low percentage of the diversion of composting materials. Though the level of service may contribute to the low participation, the city may benefit from an increased education effort of the importance of diverting composting materials from over used landfills.

In the category of Source Reduction, the city could benefit by implementing laws that are placed on manufactures to reduce waste at the source, which will automatically reduce the overall generated waste if less materials are used in the beginning. Chicago can also benefit by integrating a “pay as you throw” policy. The “pay-as-you-throw” programs are programs where residents pay for each can or bin of garbage that they set out. By implementing these programs, citizens are consciously aware of the amount of trash of which they dispose.

The score sheet presented provides as a base a city must exam to confirm their efforts in solid waste management is indeed sustainable. Though zero waste is ideal, striving to become as close as possible is highly encouraged. The Environmental Protection Agency recognizes the importance of decreasing generated waste however, at this time, has only set regulations on a state level. Because of the increasing population, it would seem America would greatly benefit from nationwide regulations to significantly reduce the amount of waste being sent to landfills daily. Chicago scored an overall 73 percent according to the score sheet created. The city’s greatest strength is the partnership it has established with its citizens. Chicago first started with the Blue Bag program and with resident feedback, took a more active role in the process by creating the Blue Cart program; making it easier for the residents to contribute to the cities overall recycling efforts. Chicago has successfully diverted a significant amount of waste from becoming landfilled over a period of almost 20 years, which in turns positively impacts the surrounding environment. Chicago’s success rate may be accredit too its aggressive efforts to incorporate recycling in its laws and regulations. Perhaps with further efficiency studies and consistently updating and creating government regulations, Chicago may become an example for other cities, as well as the nation to follow.

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# **Appendix A - City of Chicago Department of Environment Construction or Demolition Site Waste Recycling Rules and Regulations**

**Whereas**, pursuant to Chapters 11-4 and 2-30 of the Municipal Code of Chicago (the “Code”), the Department of Environment is charged with enforcement of environmental regulations, including waste management, within the City of Chicago; and

**Whereas**, pursuant to the authority granted by Section 2-30-030 of the Code, the Commissioner of the Department of Environment, City of Chicago, is authorized to issue rules and regulations necessary or proper to accomplish the purposes of Chapter 11-4 of the Code, and is further authorized to make reasonable administrative and procedural regulations or rules interpreting or clarifying the requirements which are specifically prescribed in Chapter 11-4 of the Code; and

**Whereas**, specifically, under Section 11-4-1905 of the Code, the Commissioner of Environment may promulgate such rules and regulations as necessary to implement the provisions of Section 11-4-1905; now, therefore,

**I, Sadhu A. Johnston**, Commissioner, Department of Environment, City of Chicago, issue the following rules and regulations pursuant to Sections 2-30-030 and 11-4-1905 of the Municipal Code of Chicago.

## **1.0 Description of Rules and Regulations**

These rules and regulations are promulgated pursuant to Sections 2-30-030 and 11-4-1905 of the Municipal Code of Chicago (the “Code”) which authorize the Commissioner of the Department of Environment to make rules and regulations as necessary to implement the provisions of Section 11-4-1905 of the Code and any rules and regulations necessary or proper to accomplish the purposes of Chapter 11-4 of the Code.

## **2.0 Definitions**

For only the purposes of these regulations, the following definitions shall apply:

The term “commissioner” means the commissioner of the environment of the City of Chicago.

The term “construction and demolition (‘C&D’) debris” means materials resulting from the construction, remodeling, repair and demolition of utilities, structures, buildings, and roads, including but not limited to the materials listed in Section 11-4-120 of the Code, but *not including* materials that are contaminated by lead, asbestos, or other hazardous materials in such a way as to render recycling illegal or impossible.

The term “contractor” means a general contractor as defined in Section 4-36-010 of the Code as well as any person engaged in the demolition or wrecking of a structure for which a permit is required under Section 13-32-230 of the Code.

The term “department” means the Department of Environment of the City of Chicago.

The term “DCAP” means the Department of Construction and Permits of the City of Chicago.

The term “recycle” has the meaning ascribed to the term in Section 11-4-120 of the Code.

The term “recycler” means a recycling facility, transfer station, or other waste handling facility permitted pursuant to Section 11-4-250 of the Code which accepts construction and demolition debris for recycling or for further transfer to a recycling facility.

The term “reuse” means i) the on-site use of reprocessed construction and demolition debris if such on-site use is authorized in writing by the Commissioner pursuant to Section 11-4-1935 of the Code; and ii) the off-site redistribution of a material which would otherwise be disposed of, for use in the same or similar form as it was produced.

### **3.0 Recyclable Construction and Demolition Debris**

3.0.1 Examples of recyclable construction and demolition debris. Any construction or demolition debris that is not contaminated by lead, asbestos, or other hazardous materials in such a way as to render recycling illegal or impossible may be recycled or reused in accordance with the definitions set forth in Section 2.0 of these regulations. Examples of recyclable construction and demolition debris include, but are not limited to:

- Bricks
- Concrete
- Masonry materials (cinder blocks, mortar etc.)
- Rock, stone, gravel
- Soil, dirt
- Sand
- Reclaimed asphalt pavement
- Wood
- Ferrous metal (iron, steel, etc.)
- Non-ferrous metal (copper wiring etc.)
- Plaster
- Gypsum drywall
- Paint
- Plumbing fixtures and piping
- Carpet and pad
- Non-asbestos insulation
- Roofing shingles and other roof coverings
- Cardboard, paper, packaging
- Plastics
- Glass
- Landscape debris

3.0.2 Sorting Recyclable Construction and Demolition Debris. Recyclable construction and demolition debris may be sorted as follows:

- a) Sorted on site and separated by C&D debris type into designated containers, in compliance with the Construction Site Cleanliness Ordinance found at Section 13 32-125 of the Code, and all other applicable laws, rules and regulations; or
- b) Placed for collection in a designated container for mixed recyclables on site and sorted off site at a properly permitted recycling facility.

## **4.0 Reporting**

4.0.1 Applicability. Each contractor, as defined in Section 2.0 of these regulations, shall report and certify under penalty of perjury the weight of construction and demolition (“C&D”) debris produced on site, the weight of C&D debris disposed of, and the weight of C&D debris that the contractor has caused to be recycled or reused for every project subject to the recycling requirements set forth at Section 11-4-1905 of the Code. Demolition projects and construction projects at the same site, but requiring separate permits, shall be considered separate projects, requiring separate reports.

4.0.2 C&D Debris Recycling Compliance Form. Reports of the percentage of C&D debris recycled or reused for each project shall be submitted at the City of Chicago Department of Construction and Permits (“DCAP”) on a form entitled the “C&D Debris Recycling Compliance Form,” prescribed by the Commissioner. The contractor shall indicate on the form:

- a) the actual weight of C&D debris generated on site, in tons;
- b) the actual weight of C&D debris recycled or reused, in tons; and
- c) such other information as may be required by the Commissioner.

Blank forms may be obtained at DCAP, Room 900, City Hall, 121 N. LaSalle Street, or at the Department’s website at [www.cityofchicago.org/environment](http://www.cityofchicago.org/environment).

In the event that the contractor deems any part of the C&D Debris Recycling Compliance Form to be inapplicable to a particular project, the contractor shall submit a letter with the form, together with any supporting documentation, explaining why such part is inapplicable. The supporting documentation shall be adequate to prove the amount of C&D debris recycled.

4.0.3 Computation of C&D Debris. When reporting C&D debris weights, the contractor shall calculate the weight in tons and round to the nearest hundredth (example: 49.537 tons shall be rounded up to 49.54 tons, and 49.533 tons shall be rounded down to 49.53 tons). When converting pounds to tons, the contractor shall use the conversion factor of one ton = 2000 pounds (example: 500 pounds divided by 2000 equals .25 tons). If a waste hauler or recycler reports C&D debris accepted or received as a volume measurement, the contractor shall be responsible for converting the volume measurement into a weight measurement. Upon request by

the Department, the contractor shall provide information to justify the accuracy of the conversion.

4.0.4 C&D Debris Log and Waste Hauler/Recycler Affidavit. For each project for which the contractor uses a waste hauler or recycler as defined in Section 2.0 of these regulations, the contractor shall submit one or more forms entitled “Construction and Demolition Debris Log and Waste Hauler/Recycler Affidavit” (“Hauler/Recycler Affidavit”) to the Department of Environment at DCAP (City Hall, Room 900) together with the C&D Debris Recycling Compliance Form. The Hauler/Recycler Affidavit shall be on a form prescribed by the Commissioner, and shall include a C&D debris log which accounts for the weight or volume of all C&D debris collected or accepted from the contractor by the waste hauler or recycler. The Hauler/Recycler Affidavit shall be signed before a Notary Public by an individual with the knowledge to certify the weight or volume of C&D debris that was accepted or collected.

4.0.5 Payment of Penalty. When the required recycling percentages are not met, the contractor shall calculate the amount of penalty owed pursuant to Section 11-4-1905(6) of the Code, by following the instructions on the C&D Debris Recycling Compliance Form. When a penalty is due, the contractor shall remit payment, via check or money order, to the “City of Chicago Department of Revenue” located at City Hall, 121 N. LaSalle Street, Room 107A. The original receipt from the Department of Revenue shall then be attached to the C&D Debris Recycling Compliance Form and submitted at DCAP.

4.0.6 Election Form and Contractor Affidavit. Upon completion of all information requested in the C&D Debris Recycling Compliance Form, the contractor shall select one of three options on the election form, which is included with the C&D Debris Recycling Compliance Form, to indicate:

c) that the contractor has complied with the recycling requirements set forth in Section 11-4-1905 of the Code, and that all the information provided on the C&D Debris Recycling Form, and attached thereto, is correct;

d) that the contractor paid the penalty calculated on the C&D Debris Recycling Compliance Form; that all the information provided therein and attached thereto is correct; and that the contractor will not contest the penalty; or

e) that the contractor completed the C&D Debris Recycling Compliance Form in full; that all the information provided therein and attached thereto is correct; and that the contractor requests a hearing on the applicability of Section 11-4-1905 of the Code and/or the amount of penalty due. The contractor shall then sign the Contractor Affidavit before a Notary Public and submit it in accordance with Section 4.0.8 of these regulations.

4.0.7 Opportunity for Hearing. If the contractor wishes to contest the amount of the penalty due and/or the applicability of Section 11-4-1905 of the Code, the contractor shall request a hearing by checking the appropriate box on the C&D Debris Recycling Compliance Form. In such case, the Department of Environment will issue a Notice of Hearing to the contractor in accordance with Section 2-14-074 of the Code.



4.0.8 Submission of Forms. Within thirty (30) days of completion of a project subject to Section 11-4-1905 of the Code, the contractor shall submit the completed, signed, and notarized C&D Debris Recycling Compliance Form, together with the Waste Hauler/Recycler Affidavit and any other documents required by the Commissioner, by delivering the forms in person or by mail to the Department of Environment at DCAP, City Hall, Room 900, 121 N. LaSalle Street, Chicago, IL 60602.

4.0.9 Declared Completion Date. For purposes of beginning the 30-day time frame for submission of the C&D Debris Recycling Compliance Form, permit applicants for projects subject to Section 11-4-1905 of the Code will be required to provide a declared completion date at the time of permit application. If the projected completion date changes, the contractor shall provide DCAP with written notification of the amended declared completion date. In case of a conflict between the declared completion date and the actual completion date, the 30-day time frame will begin to run with the actual completion date. For purposes of this section, the completion date shall be defined as follows:

- a) For construction and rehabilitation projects: the completion date shall be the date of completion of work as stated to the Department of Buildings in a request for a final inspection or, if no completion date is given to the Department of Buildings, then the completion date shall be the date the Department of Buildings conducts a final inspection prior to issuance of the Certificate of Occupancy, whether or not the project passes the final inspection.
- b) For demolition projects: the completion date shall be the date on which all demolition work on the building is completed.

## **5.0 Books and Records**

5.0.1 Maintenance of documentation. Contractors shall maintain copies of the C&D Debris Recycling Compliance Forms submitted to the Department, and the original documentation that supports the weight of recycled, reused, and disposed of C&D debris reported on these forms, for at least three (3) years after the date the C&D Debris Recycling Compliance Forms were most recently submitted to the Department pursuant to Section 4.0 of these regulations. The reports and original supporting documents must be maintained at the contractor's address listed on the C&D Debris Recycling Compliance Form, or such other address if the contractor notifies the Department of a change of address, and must be available for inspection upon reasonable request by the commissioner or the commissioner's designee.

5.0.2 Supporting documentation. Upon request by the commissioner or the commissioner's designee pursuant to an audit to verify compliance with the recycling requirements set forth at Section 11-4-1905 of the Code, the contractor shall provide the information specified in the audit request. Supporting documentation shall include, but is not limited to, the following information:

- a) For all C&D debris generated, recycled, reused, and disposed of, documentation setting forth the weight or volume of the C&D debris and the date and place of disposition of the C&D debris.

Such documentation may include, but is not limited to, manifests, bills of lading, invoices, receipts, and weight tickets.

b) For C&D debris reused off-site, the documentation must include the name, address and telephone number of the facility, business or organization accepting the material for reuse, the date the material was accepted, and the types and amount of material accepted.

c) For contaminated C&D debris deducted from the total amount produced on site pursuant to Section 11-4-1905(1)(b), the documentation must specify the total weight of the contaminated C&D debris, by tons, the type of contamination, and the date and place of disposition of the contaminated C&D debris.

d) For C&D debris weights that the contractor has converted from volume measurements in accordance with Section 4.0.3 of these regulations, the documentation must include a statement from the contractor explaining the contractor's method of conversion.

#### **6.0 Certificate of Occupancy**

The Certificate of Occupancy for a project subject to the recycling requirements set forth at Section 11-4-1905 of the Code may not be issued by the Department of Buildings to a contractor until the contractor submits a C&D Debris Recycling Compliance Form and thereby certifies compliance with Section 11-4-1905 of the Code or requests a hearing on the applicability of that section or the amount of fines imposed there under. If a contractor should fail to submit a C&D Debris Recycling Compliance Form, then a property owner may apply to the Department of Buildings for a certificate of occupancy if:

a) the property owner is not the same legal entity as the contractor; and

b) the property owner submits to the Department of Buildings an affidavit, signed before a Notary Public, in which the property owner states that the contractor cannot or will not submit a C&D Debris Recycling Compliance Form and sets out the property owner's basis for this statement.

I, Sadhu A. Johnston, hereby promulgate the foregoing Construction or Demolition Site Waste Recycling Rules and Regulations on this 28<sup>th</sup> day of February 2006.

## **Appendix B - Composting Ordinance**

**WHEREAS**, the City of Chicago wishes to promote responsible composting as a means of diverting waste from landfills and creating nutritive soil amendments. Now, therefore;

**BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF CHICAGO:**

**SECTION 1.** Chapter 7-28 of the Municipal Code of Chicago is hereby amended by adding the language underscored or deleting the stricken language as follows:

### **7-28-710 Dumping prohibited.**

(a) It shall be unlawful for any person to place, leave, dump, or permit to accumulate any garbage or trash in any building, structure or premises so that the same shall afford food or harborage for rats, or to dump or place on any premises, land or waterway any dead animals or waste vegetable matter of any kind.

In addition to any other fine or penalty for violation of this section, any person who violates this section shall be liable to the city for three times the amount of all costs and expenses incurred by the city in abating a nuisance caused by such violation.

(b) Nothing in this section shall prohibit the composting of organic waste or land application of composted organic waste in accordance with Sections 7-28-715 and Chapter 11-4 of this Code. Each and every violation of 7-28-715 or any rule or regulation promulgated there under constitutes a separate violation of 7-28-710(a). For the purposes of this section and section 7-28-715. The following definitions apply:

"Compost" means the humus-like product of the process of composting organic waste, which may be used as a soil conditioner.

"Composting" means a controlled biological treatment process by which microorganisms decompose the organic fraction of waste, producing compost.

"Composting material" means organic waste undergoing composting.

"Composting operation" means all composting activities conducted on a site, including all composting material stored landscape waste and end- product compost located on an site at any one time.

"Food waste" means the source-separated organic portion of the waste resulting from the handling processing preparation cooking and consumption of food and the wastes from the handling processing storage and sale of produce. "Food waste" does not include packaging utensils or containers from the handling processing preparation cooking and consumption of food.

"In-vessel" means composting which is conducted entirely within a fully enclosed container, with no opening having a dimension greater than ¼ inch in any direction.

"Landscape waste" means grass or shrubbery, cuttings leaves tree limbs and other materials accumulated as a result of the care of lawns, shrubbery, vines and trees. and includes any discarded fruits, vegetables and other vegetative material generated in the care of a garden.

"Organic waste" means food waste landscape waste wood waste or other non-hazardous carbonaceous waste that is collected and processed separately from the rest of the municipal waste stream.

"Vector" means any living agent, other than human, capable of transmitting indirectly, an infectious disease.

"Wood waste" means untreated. unpainted and unvarnished wood.

#### **7-28-715      Composting Standards.**

Any composting operation which meets the qualifications of paragraphs (3), (4), or (5) of this section shall be exempt from the permit requirements of Chapter 11-4 of this Code.

*General composting standards.* All composting operations which meet the qualifications of paragraphs (3). (4) or (5) shall promote proper conditions for composting and shall operate under the following standards. in addition to all applicable local. state and federal laws. rules and regulations:

(a) *Nuisance.* In no event shall any composting activities be conducted in a manner which creates an odor, litter, dust or noise nuisance, or attracts vectors or pests.

(b) *Rat and other vector control.* The presence of insects rodents birds and other vectors or pests shall be controlled through specific measures. These specific measures may include grinding the ingredients, providing screens or netting, or conducting the composting operation in-vessel.

(e) *Moisture level.* The moisture level of the composting material shall be maintained within a range of 40% to 60% moisture.

(f) *Sewage restriction.* The composting material shall not contain sewage. Sludge, septage or catch basin waste. For the purposes of this section. "sewage" shall have the meaning ascribed to it in Section 11-4-120 of this Code; "sludge" shall mean any solid. semi-solid. or liquid waste generated from a municipal, commercial, or industrial wastewater treatment plant. water supply treatment plant. or air pollution control facie or any other such waste having similar characteristics or effects; "septage" shall mean the waste found in a septic tank; and "catch basin waste" shall mean the waste found in a catch basin. .

.....

(1) *Garden Compost Operation.* A composting operation that composts only landscape waste shall be exempt from the permit requirements of Chapter 11-4 of this Code if it meets the following criteria:

(a) *Ingredients.* The composting operation composts only landscape waste

(b) *Noncommercial.* The composting operation is not engaged in commercial activities related to composting, the acceptance of landscape waste or commercial landscaping

(c) *Size.* The composting operation contains no more than a total of 10 cubic yards of landscape waste, composting material and end product compost on-site at any one time, unless express written authorization has been issued by the commissioner of streets and sanitation allowing a greater volume, not to exceed 25 cubic yards.

(4) *On-site Organic Waste Composting Operation.* A Composting operation that composts food waste and/or non Hazardous carbonaceous waste, whether or not landscape waste is added to the composting mixture, shall be exempt from the permit requirements of Chapter 11-4 Code if it meets the following criteria.

(a) *ingredients.* The composing operation composts only organic waste that is generated on-site

(b) *In-vessel requirement.* Any composting of food waste and/or non hazardous carbonaceous waste is conducted in-vessel. This requirement also applies to mixtures of landscape wastes with these wastes.

(c) *Size.* The composting operation contains no more than a total of 5 cubic yards of landscape waste, composting material and end product compost on-site at any one time unless express written authorization has been issued by the commissioner of streets and sanitation allowing a greater volume.

(d) *Compost use.* All generated compost is used on-site.

(5) In addition to those composting operations described in paragraphs (3) and

(4) all composition operations which met the criteria for a permit-exempt facility pursuant to 35 Illinois Admin. Code Section 830.105 shall meet the standards of paragraph (2) (a) through (f) of this section, in addition to all applicable local, state and federal laws, rules and regulations.